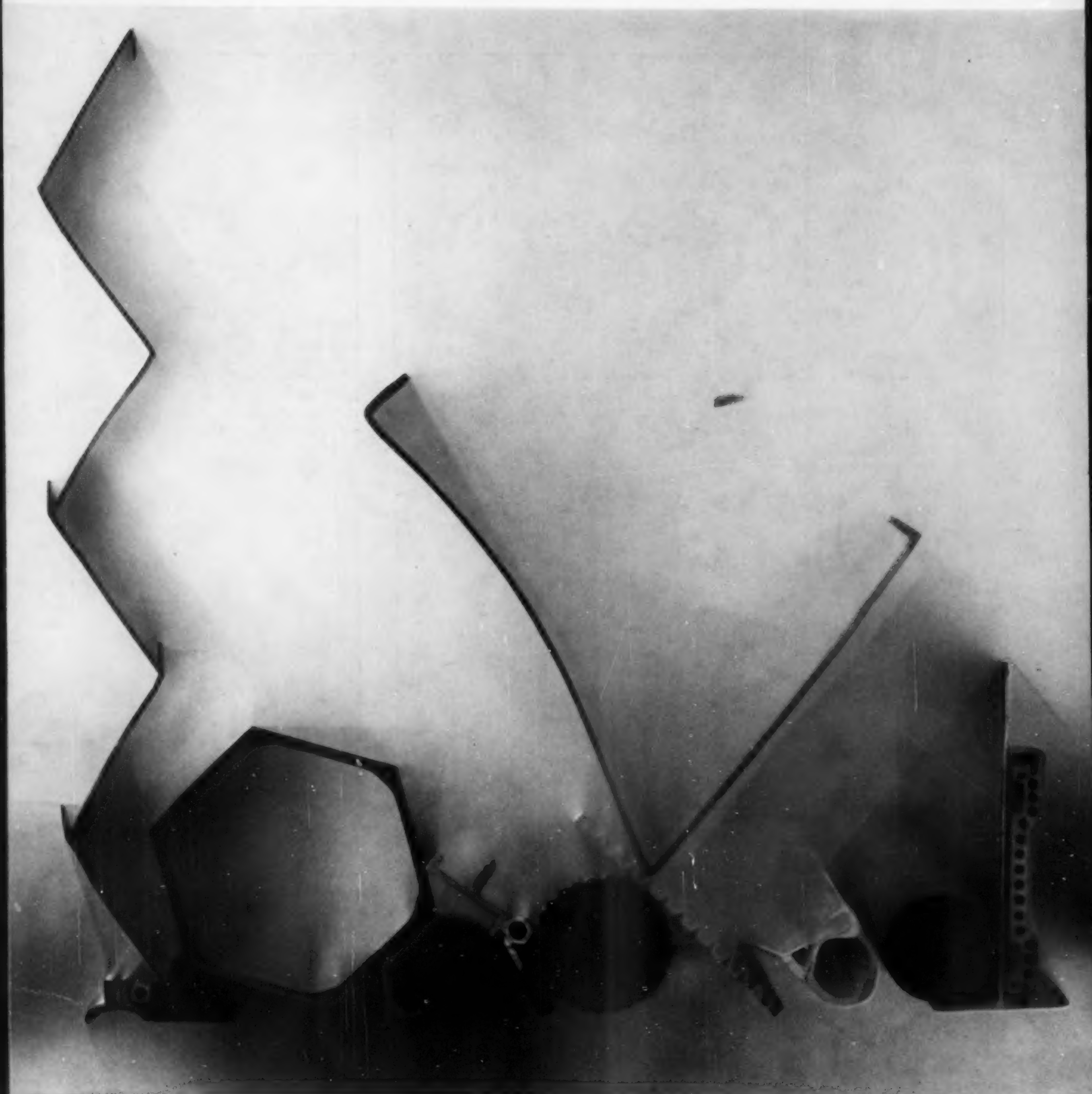
MODERN PLASTICS

OCTOBER 1959



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MODERN

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OCTOBER 1959
Volume 37 Number 2

PLASTICS*

ENGINEERING

TECHNICAL

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DEPARTMENTS

Coming Up . . .

The chart of self-extinguishing plastics, promised for October, grew too big to handle in the time available, so will appear in November issue . . . November lead will present prospective markets for blow molding . . . A cover picture and an article on new low-cost, even disposable, luxury window drapes made of polyethylene . . . More in the series on epoxies, these dealing with adhesives and printed circuits . . . An article on the first commercial Delrin applications. . . . Engineering lead will show new methods of dry coloring polypropylene . . . Also a comprehensive coverage of filament winding methods . . . December cover and a major article will describe the design, production, and construction of the reinforced plastics U. S. pavilion for the Moscow exhibition . . . and a report on the plastics exhibition currently in Düsseldorf, W. Germany.

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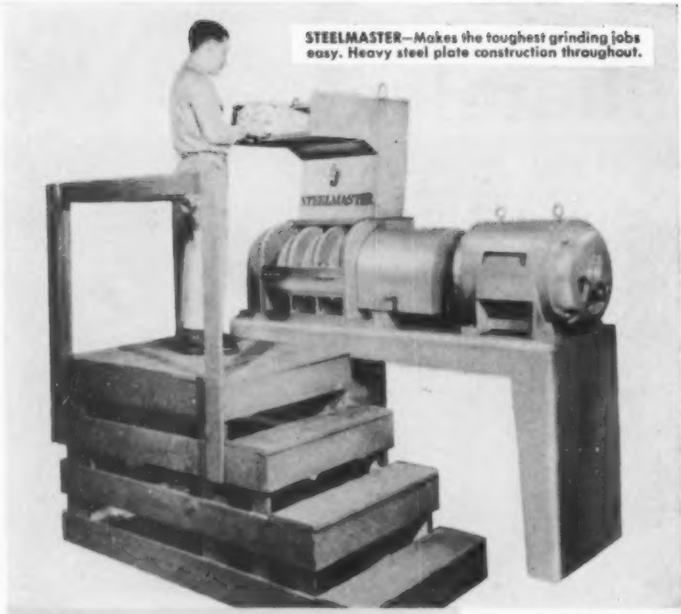

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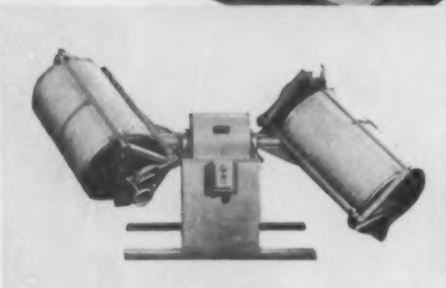

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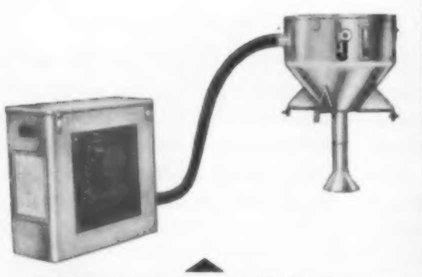

HEATER-DRYER (HOPPER ATTACHMENT)
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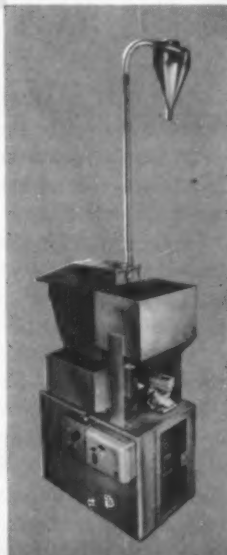

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Acetate Sheeting

by **JOSEPH DAVIS PLASTICS COMPANY** helps them sell better. These two examples—the square box for a can opener, the round one for candy—were fabricated by **J. E. Sales**, New York City, using JODA crystal clear acetate. Round or square, plastic boxes can easily be made of this sparklingly transparent material and are a strong, attractive package that will protect the product from handling, shelf and transportation wear as well as display it to its best advantage. And JODA acetate is perfect for blister and skin packaging, too.

JODA extruded acetate sheets, rolls and film in all gauges—transparent, translucent or opaque—are excellent for vacuum forming. Why not investigate the advantages of JODA acetate and see for yourself how it can help solve your packaging problems.

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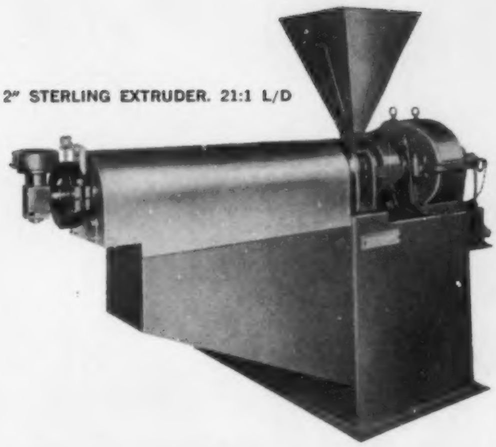

4½" STERLING EXTRUDER. 21:1 L/D

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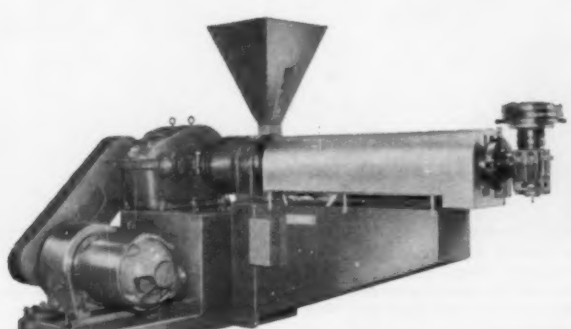
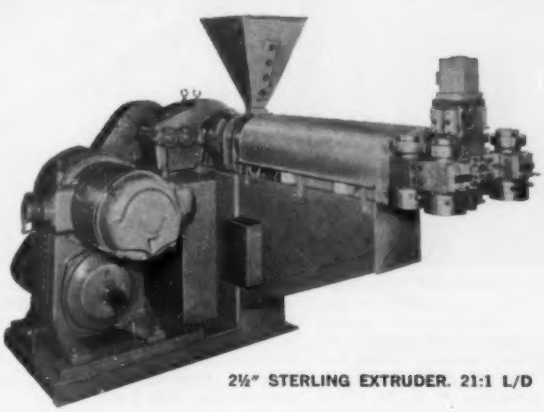


3½" STERLING EXTRUDER. 21:1 L/D



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STERLING EXTRUDERS — *"Designed by plastics men for plastics men"*

CHEMICAL-RESISTANT diaphragm and insert tube of ALATHON are unaffected by toothpaste which is striped by squeeze pressure and capillary attraction. (Parts molded by Gibson Associates, Cranford, N. J., for Lever Brothers Company, N. Y., N. Y.)

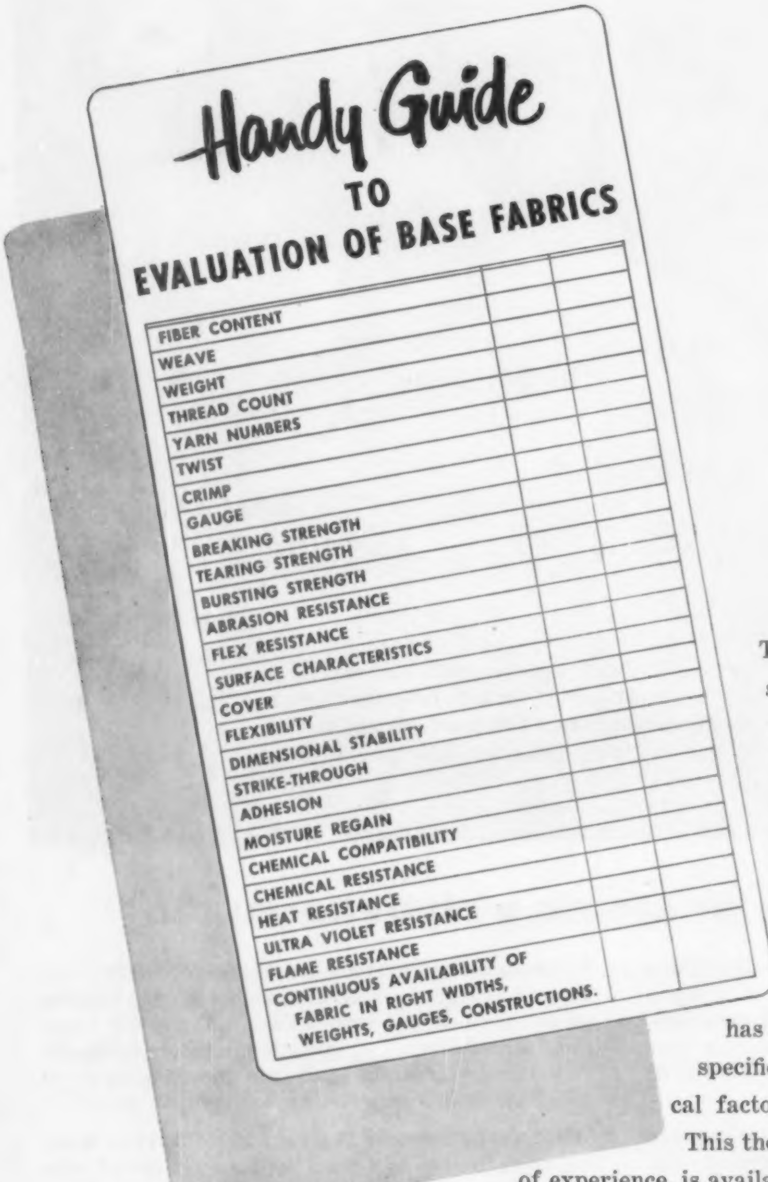
FLEXIBLE bulb of stress-resistant ALATHON holds water for portable steam and dry iron. Rustproof part eliminates need for extra equipment, is unaffected by heat of iron. (By Royal Mfg. Co., Prescott, Arizona, for General Electric, New York, N. Y.)

COLORFUL lids molded of ALATHON are readily printed upon to give instant product recognition and extra sales appeal to food packages. They snap easily on and off, seal tightly, are odorless and tasteless. (Lids by Mutual Plastic Mold Corp., South Gate, Cal.)

RUSTPROOF protector of durable ALATHON is easily installed, keeps litter from clogging gutter. Water enters gutter through scalloped edges of the tube. (Mfd. by Jessall Plastics, Kensington, Conn., for JO-LI-ET Gutter Gard Corp. Glenbrook, Conn.)

ALATHON® POLYETHYLENE

Photo courtesy Bedminster Sound Corp., Belleville, N. J.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TEARING STRENGTH
BURSTING STRENGTH
ABRASION RESISTANCE
FLEX RESISTANCE
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COVER
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DIMENSIONAL STABILITY
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ADHESION
MOISTURE REGAIN
CHEMICAL COMPATIBILITY
CHEMICAL RESISTANCE
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FLAME RESISTANCE
CONTINUOUS AVAILABILITY OF FABRIC IN RIGHT WIDTHS, WEIGHTS, GAUGES, CONSTRUCTIONS.

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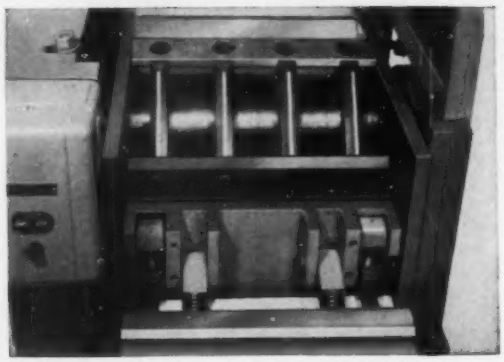
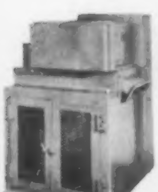
GRANULATING MACHINES

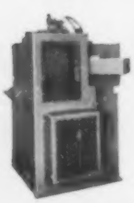


PART OF THE COMPLETE LINE OF CUMBERLAND PELLETIZERS, BESIDE THE PRESS AND CENTRAL GRANULATING MACHINES, DICERS, CHOPPERS AND PRE-BREAKERS



CUMBERLAND PELLETIZING MACHINE

New feed roll mechanism provides better control of extruded strands of plastic materials. Cuts cubes or pellets 1/32" to 1/2". 14" and 24" openings.



STAIR STEP DICER

Produces perfect cubes or pellets 1/16" to 1". Two standard sizes accommodate up to 7" and up to 14" ribbons.

LARGE THROAT OPENINGS – 12" x 16" (Shown above). Also 7" x 10", 8½" x 12", 8½" x 16", 12" x 20".

QUALITY CONSTRUCTED entirely of steel weldments. Advanced design leaves all working parts readily accessible for cleaning and adjustment of knives.

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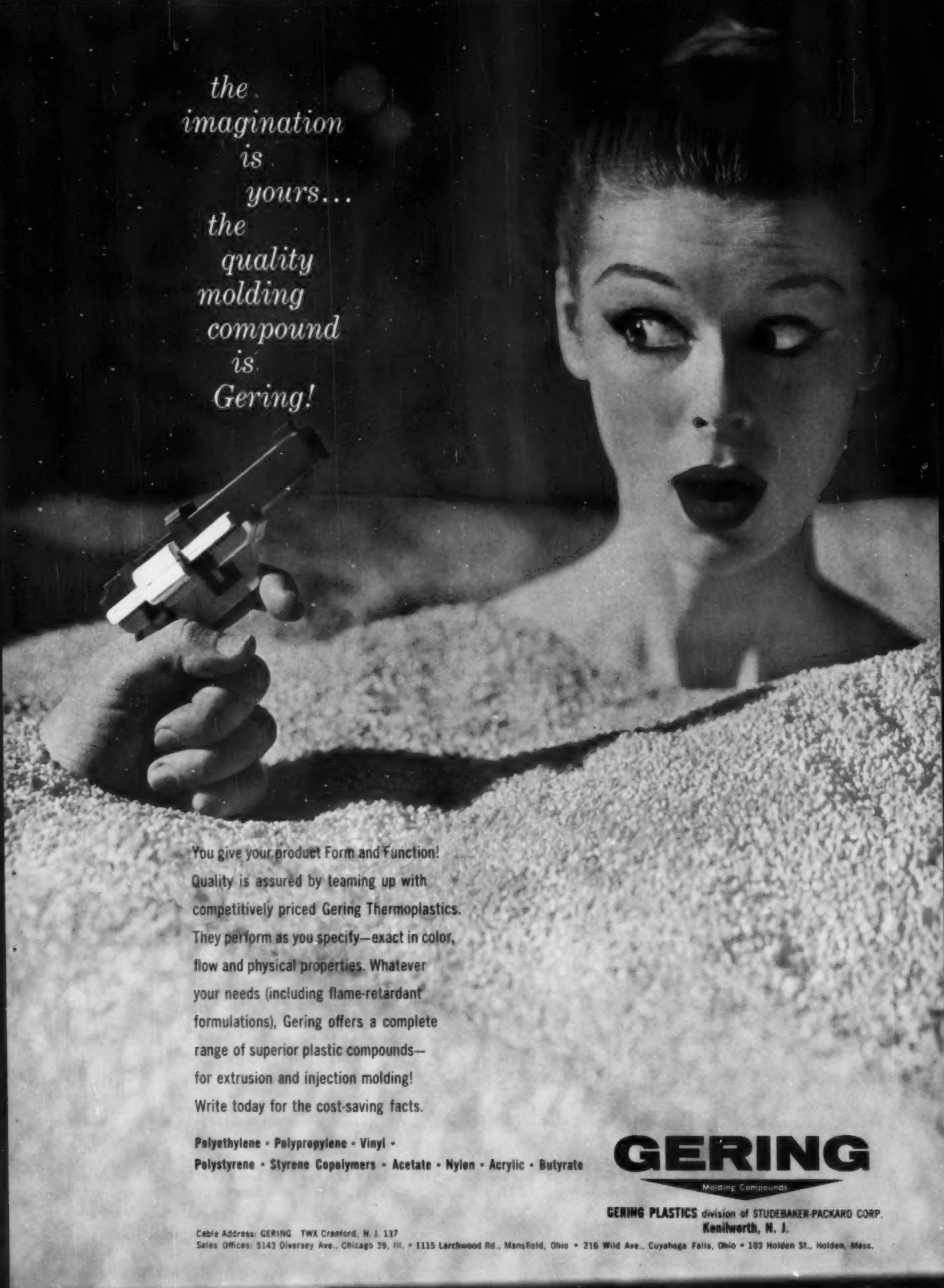
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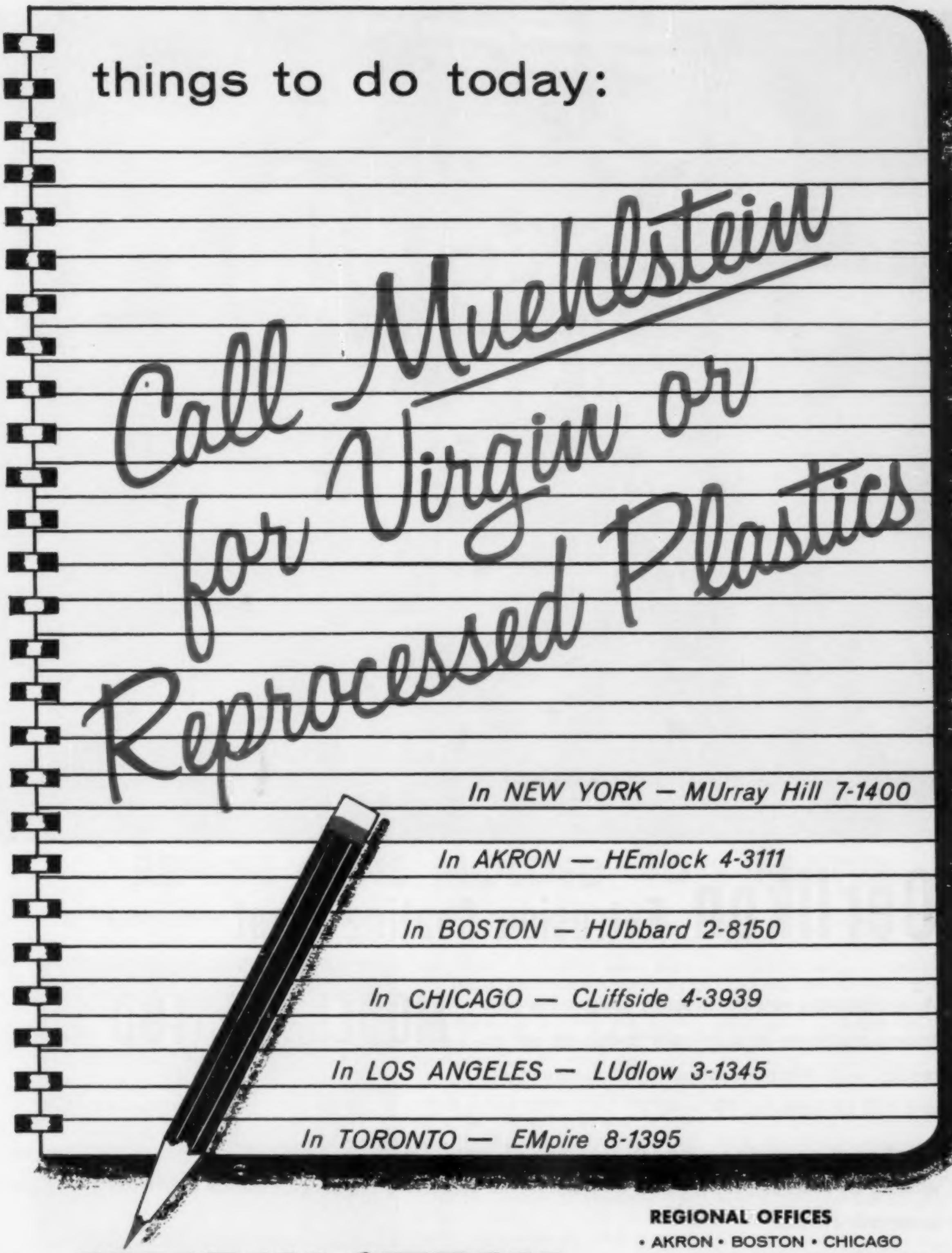
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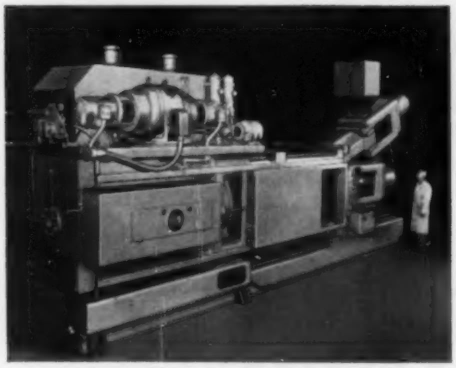
This refuse can represents the extra bonus Rubbermaid gets for every 3 cans molded on their new H-P-M 200 oz.

REFUSE CANS MOLDED 50% FASTER

A Report From Rubbermaid, Inc. On The New H-P-M 1000-P-200 Preplasticizer



Here are the "specs" that can put you in a new production class, too: 1000 tons clamping pressure; 200 oz. injection capacity; 65" daylight (79" with ejector box removed); 45" stroke; 39" x 60" mold mounting space; 4050 cu. in. per min. injection rate (5300 cu. in. per min., optional).

M. "Slim" Krajcik, Plastics Supt. for one of the country's top-quality molders, Rubbermaid, Inc., Wooster, Ohio, says, "We are really happy with our new H-P-M 1000-ton machine. We now can mold 3 cans in the same time it took to mold 2 in another make machine. It's the busiest machine in the plant. Maintenance has been negligible."

With 1000 tons clamp pressure, 200 oz. material capacity per "shot", plenty of mold mounting area, and accurate shot control, you'll be amazed at what this machine can do for you. It permits taking on jobs unheard of a few years ago . . . deeper drawn parts with larger projected areas which are now in production, or on the design board. It's turning out such parts at high production rates.

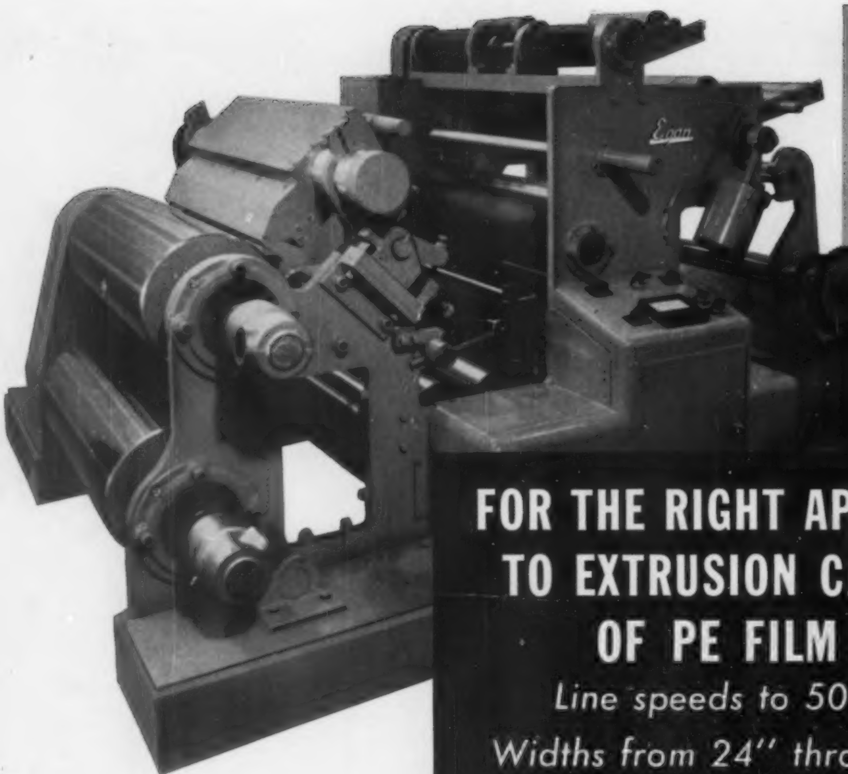
Yes, a couple hundred additional tons clamping pressure is the difference between molding large parts and *really big ones*. With this new H-P-M you can do both, economically. Write for complete information, today.

THE HYDRAULIC PRESS MFG. COMPANY

HPM

A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

H032



FOR THE RIGHT APPROACH TO EXTRUSION CASTING OF PE FILM . . .

Line speeds to 500 fpm

Widths from 24" through 120"

It pays to rely on Egan precision engineered equipment for completely packaged extrusion casting installations!

EGAN FILM CASTING UNITS include these features: highly polished, chrome-plated casting rolls with spiral baffling for even temperatures; a specially designed air-knife with an adjustable assembly for controlling "frost line" and assuring uniform film contact across full face of roll; edge trimmer assembly; trim disposal system; turret type winder with electronic drive for each winding position to provide programmed tapered tension, and web cut-off and transfer at operating speeds.

EGAN HEAVY DUTY EXTRUDERS have been tested and proven in the field! These dependable, high-capacity, low maintenance units are available in sizes from ¾" through 10". Economical ceramic heater bands provide fast heat-up time and operating economy. The overall extruder components assure closer tolerances and uniform gauge. For absolute control of heating, cooling, and excessive frictional heat, the patented "Willert Temperature Control System" may be included. Complete instrumentation is included.

EGAN DIES for cast film installations are of the manifold type with provision for die blade adjustments. Heaters are divided into separate zones with individual pyrometer type controls. The main die body, in conjunction with a specially designed 45 degree adapter, is arranged so the casting rolls can be moved close to the die orifice.

CABLE ADDRESS: EGANCO—SOMERVILLE (NJER)

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Manufacturers of plastics extruders, dies, take-offs, and other accessories

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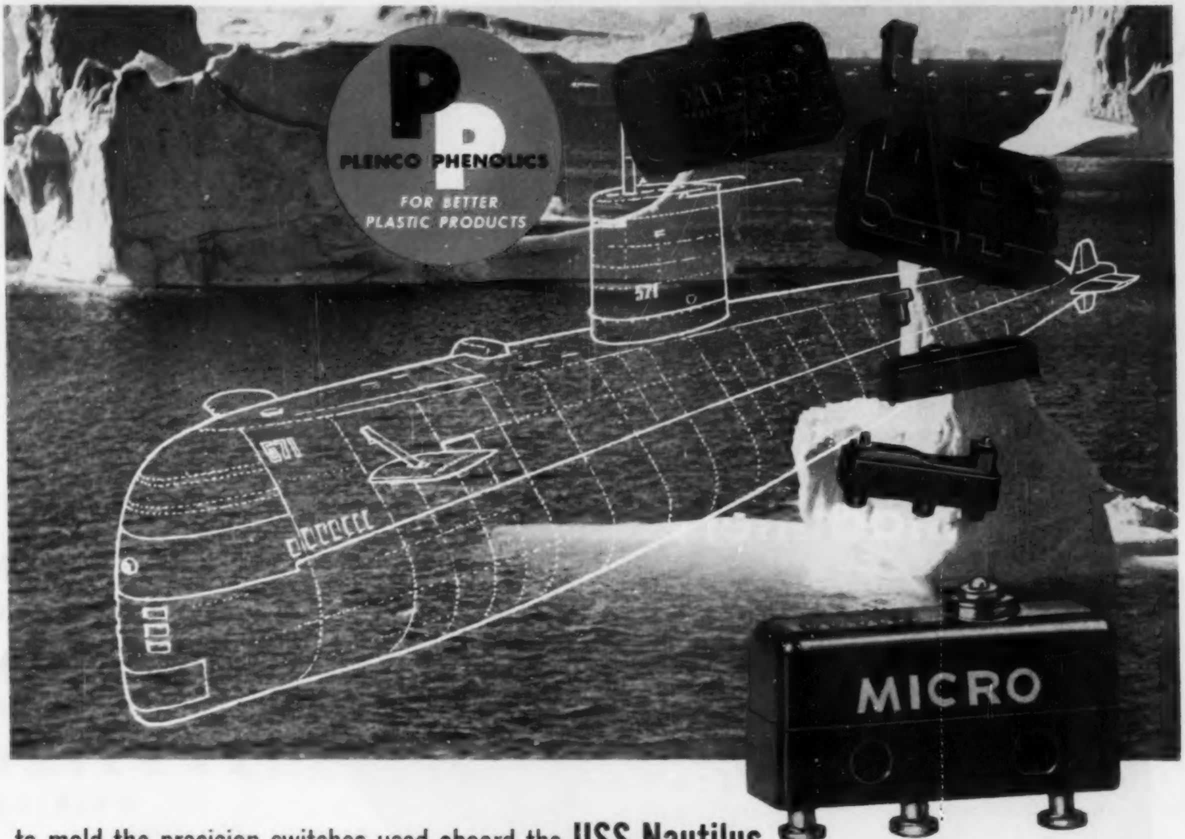
IF PHENOLICS CAN DO IT, **PLENCO** CAN PROVIDE IT—AND DOES—FOR **MICRO SWITCH**



to mold the precision switches used aboard the **USS Nautilus,**

Minneapolis-Honeywell's **MICRO SWITCH** division specified

PLENCO

THE HAZARDS that exist for underwater Arctic seamen at the top of the world are many.

A conventional magnetic compass, for example, is unreliable and useless as an instrument for indicating direction in that area. Yet, the atomic powered USS Nautilus, in its historic first transpolar crossing, was able to avoid the danger of unknown position or track. Aboard were MICRO SWITCH subminiature switches, part of the Controls System of the most advanced navigational equipment available.

So incredibly precise are these subminiature switches that the movement required to actuate them is as slight as *thirty-thousandths* of an inch. Assured dimensional stability of switch housings, covers and components, under the most adverse conditions of exposure and physical abuse, is therefore vital. For such assurance, MICRO SWITCH engineers specify high-strength Plenco phenolic compounds.

In the molding of these elements of the miniaturized switches, as well as those of the larger limit switches, Plenco molding compounds meet the specified requirements—minimum moisture absorption; maximum dielectric strength; and, of course dimensional stability. All contribute to the proved reliability of MICRO SWITCH precision snap-action switches in the Controls Systems of industrial installations everywhere.

Through scrupulous quality standards and an extensive selection of general and special-purpose compounds, Plenco contributes similarly to many other industries. We'd like the opportunity to apply them to *your* product or production problem.

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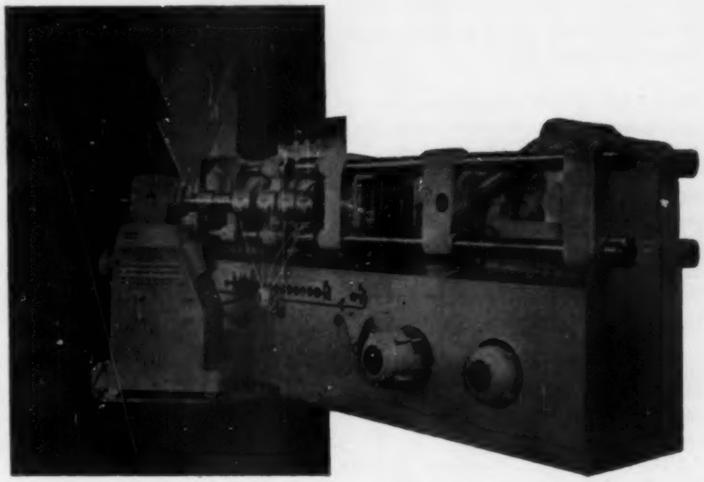

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nosco's "can do" engineering is why

Nosco's latest expansion is headline news for the user of blow molded products. After today, practical engineering will support your projects. It has been four years since our injection molding customers asked us to devote our "Can Do" engineering and production skills to blow molding. Four years of technical analysis and planning to correct prevalent deficiencies.

what engineered blow molding means to you

- ***Balanced Wall Thickness***
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For 23 years, Nosco "Can Do" has meant improved quality and craftsmanship in injection molding. Now these same high caliber engineering and production skills—plus Nosco's industry—leading finishing department — will benefit the user of blow molding services. There's a Nosco representative near you. He is competent to show you how Nosco's experience will benefit your products. Or contact us direct.

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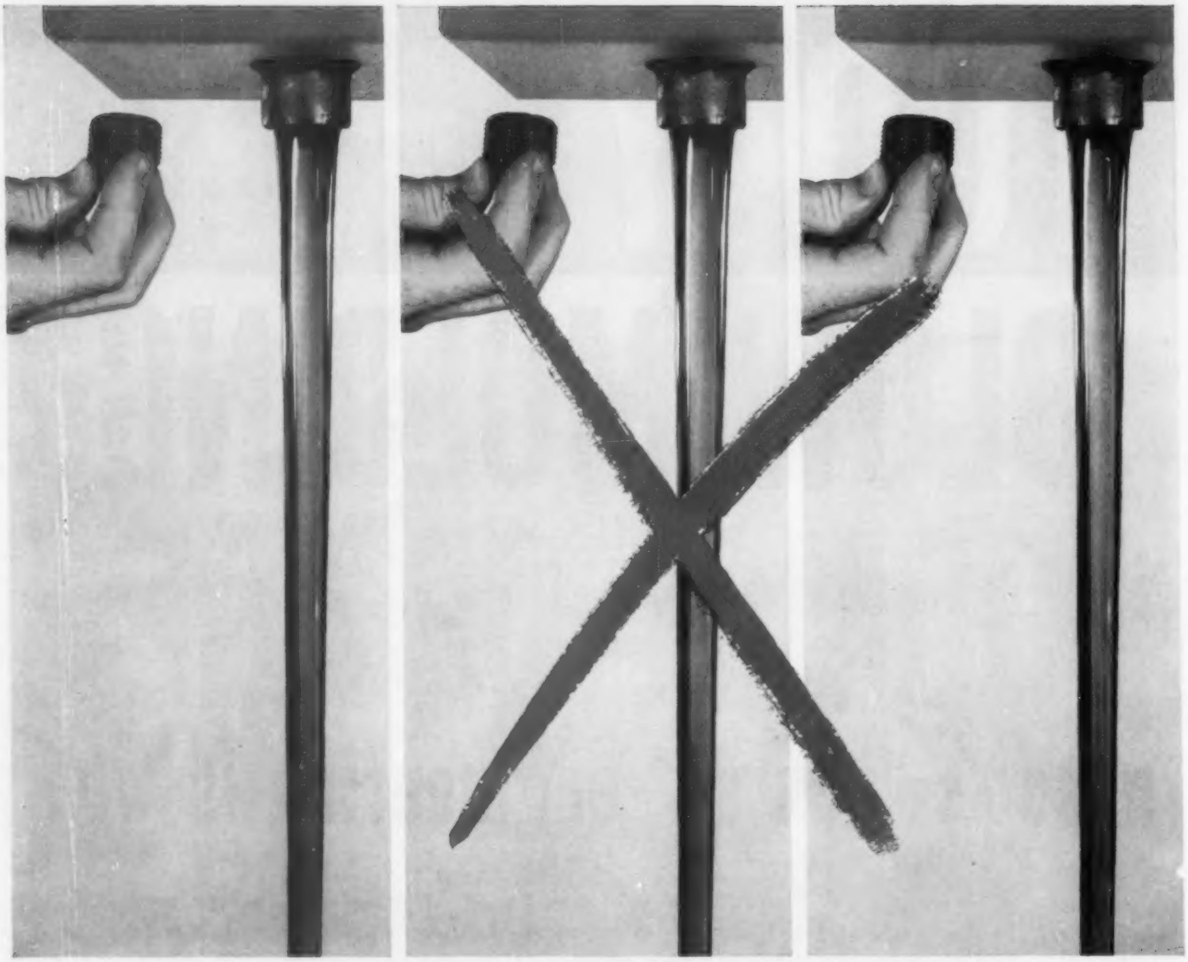

HOW TO CUT DRAIN PERIODS,
yet improve hydraulic performance!

Drain periods for a hydraulic system may be extended many times over by switching from straight mineral oils to a premium oil.

This has been proved time and again when the switch has been made to Texaco Regal Oil R&O without altering any other operating conditions.

It's obvious that draining hydraulic systems, cleaning, and replacing with new oil is costly. If one or more drainings can be eliminated the additional oil cost would be warranted.

Straight mineral oil may be satisfactory for some systems, but tests show that Regal Oil R&O can extend the interval between draining at considerable savings. This premium oil is formulated to resist oxidation, rust, foam, and wear.

And there's a bonus! When you do drain, you'll find the system in cleaner condition. Save again on make-ready.

The advantages of switching to Regal Oil R&O are so convincing that Texaco has made a film about it. We'll be happy to arrange a showing at your plant without obligation. Call the nearest of the more than 2,300 Texaco Distributing Plants, or write to:

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U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

OCTOBER, 1959 U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Lightweight polyethylene-coated corrugated containers are being used to ship heavy electric typewriters.

Polyethylene was found to be the only material that did not damage the finish of the typewriters. A polyethylene-coated corrugated insert fits over the typewriter inside the container. This liner prevents damage to the typewriter, even if the box is overturned. The box cuts costs 30 percent, and volume 40 percent. Stacking strength is increased 40 percent.

A semi-rigid polyethylene bag inside a corrugated box is being used to package a liquid industrial deodorant. The containers, in quart and gallon sizes, pour easily and are convenient to handle.

This method of packaging reportedly eliminates the problems of freezing and bottle breakage and requires no deposit or return. The new containers require less transportation and storage space than glass or metal ones, providing lower handling costs.

Courtesy Canton Containers Inc.

In an unusually large packaging job, a locomotive was wrapped in a polyethylene film cover for export shipping. The cover was specially made to protect the locomotive from dirt, dust, and water spray during overseas shipment.

A new sealing machine for polyethylene bags reportedly provides substantial savings in packaging costs. The machine features an automatic sealing and cut-off device designed to save up to an inch of film length per bag. It eliminates conventional tabs and is claimed to save up to 15 percent in material costs.

Strong, flexible bags with many properties comparable to metal cans are being produced to package foods. These bags are made of aluminum foil laminated on both sides with polyethylene film, and coated on the outside with cellophane. They are impermeable to gas and moisture. The bags will heat seal, have high impact strength, and will stretch up to 28% (in machine direction) before rupture. They may be used for vacuum packaging, dehydrated food packaging, liquid food packaging. The packages can be boiled.

Growing Market for Polyethylene Film Seen in New Construction Applications

Film Makes Ideal Moisture Barrier for House and Highway Construction

A burgeoning market for heavy polyethylene film is developing out of new uses for the film in the construction industry. Three properties of polyethylene film have been chiefly responsible for its popularity with builders. It is an excellent moisture barrier. It is light-weight, yet strong. It is inexpensive.

Polyethylene sheeting in 4 mil thickness is placed on freshly laid concrete after a film of water is sprayed over entire area. Boards are placed over the joints and edges and left in place for at least 36 hours. Sheeting can be re-used for this purpose, or used as waterproofing under next slab in multi-dwelling construction.

Construction men are using polyethylene film as a moisture barrier under foundation slabs and concrete highway sections, between interior and exterior walls, and as a lining for crawl spaces. On one recent construction job, 70,000 square feet of 4 mil clear film was used under a concrete slab. Installation was facilitated by the light weight of the film — less than 20 pounds per thousand square feet. In house and highway construction, the same film used under concrete as a barrier, is frequently reused after first serving as a cover over other concrete.

On large construction jobs, polyethylene film has proved invaluable as an inexpensive covering for open, unfinished work. The film permits solar heat and light to enter, keeps out wind and dirt.

In house construction, film is being used for window and door flashing and as an under layer for shingle roofs. Film is being laid under shower stalls and in other parts of the house where moisture and water seepage is a problem.

The future of polyethylene in the building industry continues to be brightened by new applications. For example, "bubble houses" held up by air pressure show promise as economical shelters for construction work or for temporary storage. Polyethylene-coated plywood concrete forms that are self releasing have been suggested. New uses such as these promise to continue the spectacular growth which polyethylene has shown over the past few years.

Unsupported Polyethylene "Bubble" Houses Chickens

An air supported plastic shelter, used as a low-cost house for poultry research, has been built at a leading agricultural university.

No inside supports are used for the 10 by 20 foot shelter built with 4 mil polyethylene film. A one eighth HP motor keeps the quonset shaped shelter inflated. It is estimated the building will endure 60 mph winds and support a foot of snow. The success of the shelter suggests its use in meeting temporarily expanded farm storage and poultry shelter needs.

U.S.I. To Co-Sponsor Museum Packaging Show

U.S.I. will co-sponsor an international packaging show at the New York Museum of Modern Art from Sept. 9 to Nov. 9. Several hundred commercial and industrial packages selected from ten countries will be presented. They will range from wrapping materials to a 370 cubic foot container.

The exhibition is intended to re-examine and broaden the concept of packaging in relation to the great variety of products produced today. Outstanding examples of graphic and industrial designs will be shown with emphasis on imaginative use of new and old materials. Experimental and industrial packaging seldom seen by the public will also be exhibited along with well-known commercial applications.

New Slitter Is Faster, Reduces Trim Losses

A compact new machine is reported to shorten slitting time for polyethylene film and to reduce trim losses.

It normally takes 45 minutes to cut a 10,000 ft. roll of film, using a conventional slitter and winder. The new machine is reported to cut the same length of film — on the roll — in five minutes.

When the film is slit on the extruder, three to four inches of selvage material is usually lost. The new machine reduces wasted selvage to as little as 1/16 of an inch. The new slitter eliminates the problem of fusing at the edge of the roll. The machine is said to cut film in gauges from 4/10 to 10 mil, in any width up to 72 inches.

POLYETHYLENE PROCESSING TIPS

Vol. IV, No. 5

IMPROVING EXTRUDER EFFICIENCY WITH PRESSURE GAUGE

Failure to determine the proper schedule for breaker plate and screen pack maintenance can be costly to polyethylene extruders. It can result in losses in production time and deterioration in the quality of the extruded product.

Changing a screen pack when it is not contaminated is an unnecessary waste of valuable production time. On the other hand, allowing the screen to become excessively contaminated poses serious production problems. The increased pressures that develop and the longer exposure of the polymer to heat can cause degradation and oxidation of the polyethylene. These undesirable changes in the resin's physical properties show up in off-quality end products. Excessive pressure, too, may damage the extrusion equipment.

Pressure Gauge Guides Operator

These difficulties can be reduced by installing a pressure gauge in the extruder cylinder wall between the screw and the breaker plate, as shown in the drawing, Fig. 1. The gauge continuously monitors breaker plate condition and indicates to the operator when it is time for screen pack changes.

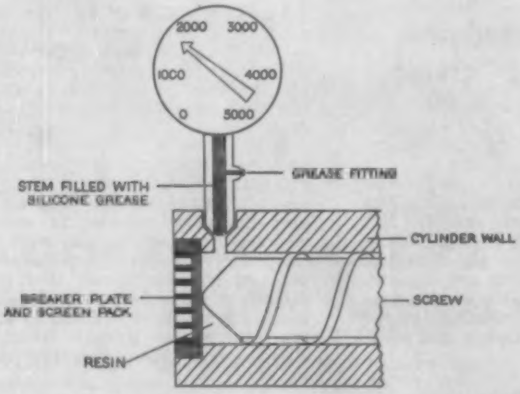


Fig. 1. Diagram of installation of pressure gauge on an extruder

As the accompanying chart, Fig. 2, shows, pressure in the cylinder increases as the area of openings in the screen pack decreases, that is, as screen plugging increases. Pressure, of course, is dependent on operating temperature, screw temperature, and screw speed as well. In practice, the operator first determines operating conditions and screen pack arrangements that produce the best results with a given product, using the pressure gauge as an aid in such preliminary runs.

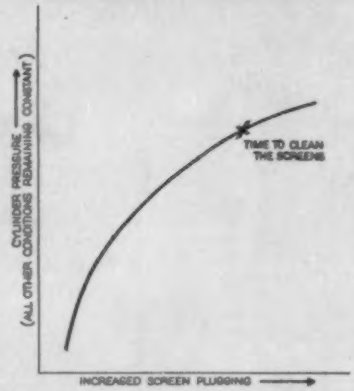


Fig. 2. Cylinder pressure increases with increasing screen plugging

Once operating conditions are established, pressure can be correlated with contamination in the screen pack and breaker plate by experience. The build-up of pressure beyond a given point is the signal that the screen pack needs changing.

How Gauge Operates

The bleeder-type bourdon tube gauge is the pressure-measuring device most commonly used in the extrusion industry. The gauge can be installed on the top or bottom or at any angle on the cylinder. The tube running from the gauge to the cylinder is filled with silicone grease introduced through a grease fitting.

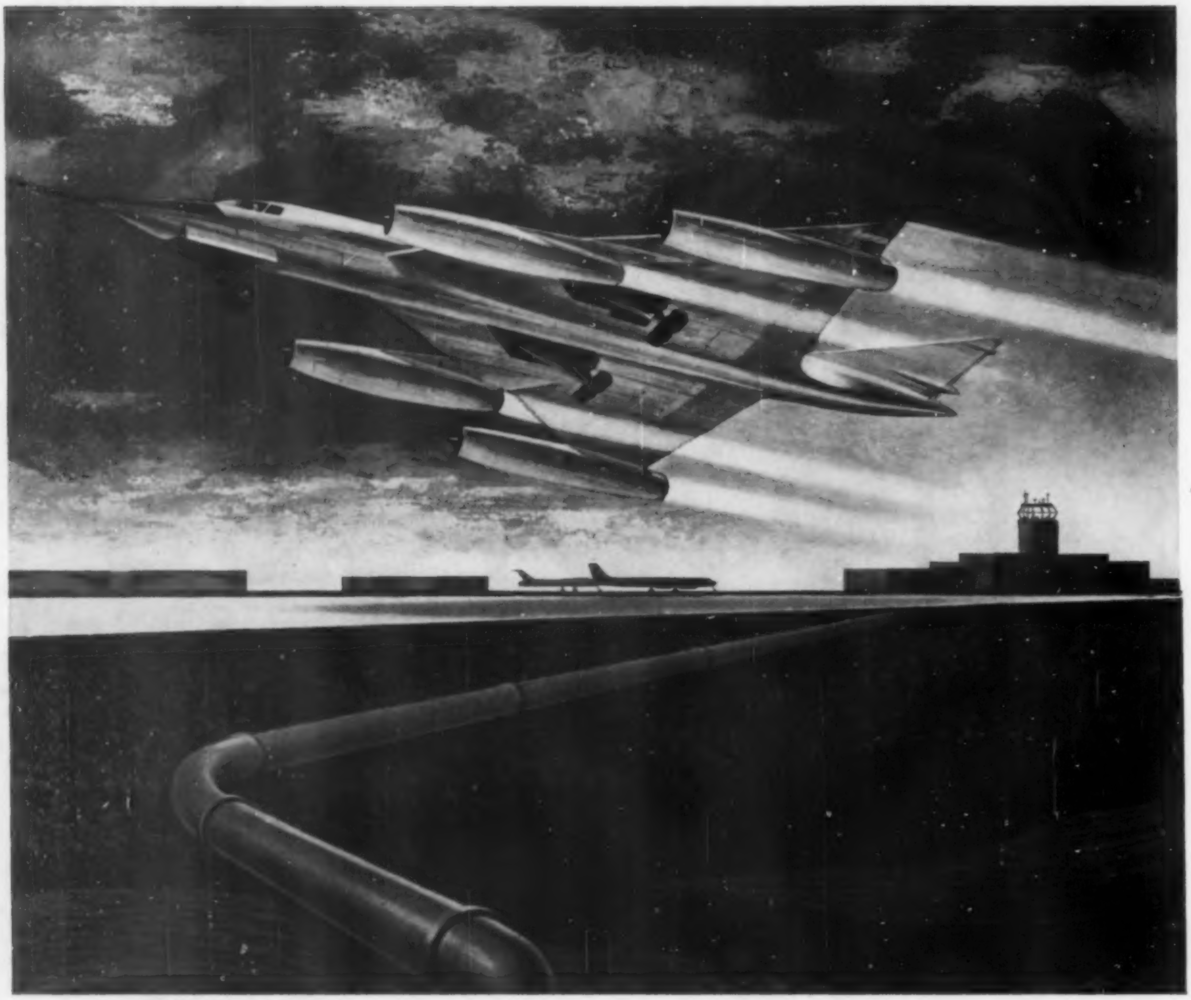
Gauge Maintenance

The tube, or stem, must be kept filled with silicone grease, or else polyethylene resin will be forced into it from the cylinder. If this happens, the resin will solidify, causing inaccurate pressure readings on the gauge. Applying grease through the fitting once every 24 hours of extruder operation should be sufficient. It is best to add the grease between production runs so that the small amount forced into the resin can be easily purged.

If the stem becomes plugged with resin, it can be cleaned quickly. The operator simply removes the stem, heats it, and purges it of resin by forcing silicone grease through it.

Technical Assistance from U.S.I.

Most troubles associated with screen pack and breaker plate maintenance should disappear with the installation of a pressure gauge. But if you have special problems, ask U.S.I. for technical assistance. Our technical service engineers will be glad to work with you in solving them.



EPON® 828 . . . from TOP to BOTTOM,

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Ever since its introduction a decade ago, Shell Epon 828 has set the pace as a uniform thermosetting plastic with a remarkably wide range of applications . . . from high-flying missiles to underground glass fiber pipe and pipe coatings. No other resin polymer combines such outstanding uniformity with *so many* other desirable properties.

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Epon 828 is used in the manufacture of many products, new and old, such as boats, tools and dies, aircraft, commercial adhesives, and vinyl stabilizers. It is a principal ingredient in surface coating formulations that give films of almost unparalleled resistance to abrasion, impact and the attack of solvents, alkalis, and acids. A new and fast-growing use is in industrial floor surfacing compounds.

The unequalled uniformity of Epon 828 assures formulators of this wide range of applications. Only Shell Chemical offers you a *complete* line of epoxies. Write to your nearest Shell Chemical district office.

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THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 1 **October 1959**

New entrants for polypropylene. Dow Chemical will build a polypropylene plant at Torrance, Calif., that will go on stream in 1961. Capacity has not been announced. This is in addition to the Bay City, Mich., plant which is scheduled for early 1960. Dow now has an estimated 100 million lb. conventional polyethylene plant in Texas, and is building an estimated 25 or 30 million lb. plant in Louisiana. The company also has a linear polyethylene plant in Bay City and another in Sarnia, Ontario. The company evidently aims to be a big factor in olefins.

Firestone has also announced it will start planning a polypropylene facility in Hopewell, Va., where a new plant for nylon tire cord will soon get under way. Firestone has had a nylon 6 (caprolactam) pilot plant in operation for five years, and is well prepared to make monofilament but is not planning to produce nylon plastic. The polypropylene venture may be instigated by Firestone's interest in monofilaments and film, since they have long been a producer of Saran monofilament which is threatened by polyolefin competition. The company was also an early producer of PE film and, of course, is a large producer of vinyl film.

Catalin has also announced availability of polypropylene in three grades: general purpose, heat resistant, and ultra-violet resistant.

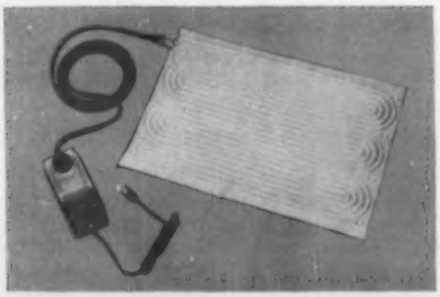
Texas Eastman has announced immediate production of PP on a limited basis—AviSun came into production in August, and Enjay is expected to be on stream early in 1960. Hercules has been operating at or near capacity since early this year. V. P. Mayfield of Hercules recently predicted a billion lb. sales for PP in the mid 1960's. There are likely to be more announced entrants in the field before this year is over.

Maleic and fumaric. Monsanto will add to its maleic capacity by 20 million lb. in mid-1960. The company will then have a capacity of 60 million pounds. Total U. S. production of maleic in 1959 is expected to be 65 million pounds. The company also announced a price reduction, from 27¾¢ to 22½¢, and stated that when the new facilities come in an even lower figure could be possible. Other producers met the Monsanto price immediately.

In the meantime, Reichhold has announced an increase from the present 15-million lb. capacity to 30 million in a new plant under construction at Elizabeth, N. J., and the possibility of expansion to 50 million. Oronite has also stated that it would start producing maleic soon. Other expansions were noted here in the August issue. Soon there will be a veritable sea of maleic anhydride, and the reason for it is obscure. The largest use is for glass-reinforced polyester. While this is a growing industry, it isn't growing fast enough to absorb all the maleic that will be around.

Another factor is the increase in fumaric acid, also used in reinforced plastics and sometimes to replace or supplement maleic. National Aniline has announced facilities to be completed in June 1960 (To page 39)

*Reg. U. S. Pat. Off.



aquamatic K-pad is a water circulating heat/cooling hospital pad with temperature ranges from 34°F to 105°F. . . . used for body temperature control in low temperature surgery. Specific requirements: low moisture absorption, flexible and soft at low temperatures, easy to clean — sanitary, and non-staining. Designed and manufactured by Gorman-Rupp Industries, Inc., Bellville, Ohio. Sheeting specially compounded and extruded by Conneaut Rubber & Plastics Company, Conneaut, Ohio.

Vygen 110 is not just another quality resin, but one of a family of specialized PVC resins developed and manufactured to meet the requirements of the processor and the demands of the end product. No matter what your processing requirement, you should look to the VYGEN family for PVC resins *just right* for every application.

Chemical Division
GENERAL
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Creating Progress Through Chemistry

The General Tire & Rubber Company · Chemical Division · Akron, Ohio

THE PLASTISCOPE

(Continued from page 37)

that will double present capacity, and stated that the company would meet the Monsanto price drop in fumaric to 22¾¢/lb. from a previous 27¼ cents. Monsanto stated that its new addition to maleic capacity is expected to bring its fumaric acid costs substantially lower through related production economies.

DOP on allocation. Because of the shortage of napthalene from which phthalic anhydride and then DOP is produced, the latter has been placed on allocation by most producers. At this writing only 60% of contract commitments are being supplied. The shortage was created by the steel strike, because napthalene is largely a by-product of coking ovens. When the strike ends it will probably require at least five weeks to catch up with demand and a rise in price next January or February is a possibility. Vinyl chloride resin users must find replacements for phthalate plasticizers at considerably higher cost than 25¢ DOP. Polymerics will help but they start at around 39 cents. TCP can be used in some cases where color is not critical, but it is over 30 cents. More adipates, azelaics, and sebacates can be used where low-temperature flexibility is necessary, but they too are costly. It is possible that necessity will force development of new plasticizer combinations never used before.

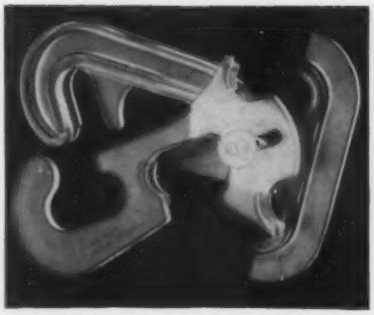
Benzene, also partially dependent on coke ovens, is not quite so critical, since the petroleum industry is now furnishing from 17 to 18 million gal. a month, compared with 12 million in 1958. Also there is imported benzene which can be used for styrene—but it isn't suitable for phenol.

Price reduction in medium density PE. Spencer Chemical has reduced the price of the company's Hi-D 0.935-density PE resin from 42 to 40¢ a pound. This resin has been used up to now primarily for paper coating. It is a high-pressure processed resin with a density that approaches that of low-pressure resins. High-density linear resins have not yet been promoted for paper coating.

The Spencer medium-density resin is particularly adaptable for paper coating because its higher density is said to give greater grease resistance and low permeability to water and gas vapors. The processor can use a thinner coating and promise his customer the same protection he would get from a thicker coating of lower-density resin; and thus the more expensive per lb. resin becomes economical on a basis of sq. ft. coverage. However, other producers have begun to enter the market and it is assumed that Spencer has reduced the price to meet this competition.

Lower price for molding grade high-density. Phillips Chemical has reduced the price of several types of high-density, linear PE from 38¢ to 35¢ a pound. The resins affected are used principally in housewares and toys. The types reduced are 6035 and 6050 (0.960 density) and the copolymers 5040 and 5065, of 0.950 density. Colors and black in these same resins were reduced from 44 to 41 cents. No. 5040 with an M.I. of 4.0 is used principally for molding smaller items —it has good moldability and is less likely to stress crack than 5065 which has an M.I. of 6.5 and is more susceptible to environmental stress crack. It is used for water quenched clear film by at least one film producer. Nos. 6035 and 6050, with melt indexes of 3.5 and 5.0 respectively, are stiffer **(To page 41)**

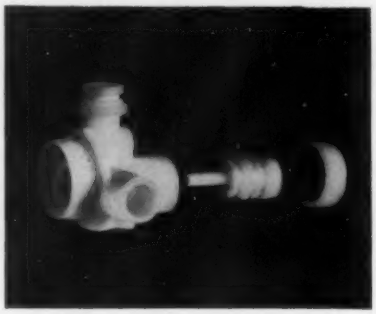
1 Nylon replaces metal in this idling cam. made by Chicago Molded for Holly Carburetor. By injection molding it of nylon, CMPC eliminated 3 operations—hardening, stamping, and assembly . . . cut production costs 50%. A unique mold design provides for easy changes in the number and sizes of ratchets at minimum expense. By any measure of value analysis, this is *designing for profit.* Think how this foresight could benefit your product, your profit.



2 This molded plastic suspension clamp, used for spacing power cables, has installation-ease and maintenance savings designed into its 4 integrated acrylic parts. The two-piece clamp body is fastened securely with a special bolt and nut, also acrylic. Injection molded, the clamp saves up to 60% of the cost of conventional systems—another example of designing for profit with plastics by CMPC.

3 Linear polyethylene replaces brass in this deep-well component injection molded by Chicago Molded for Red Jacket Manufacturing Company. By applying the right plastic material and molding method, CMPC solved a long standing corrosion problem and improved pump efficiency. Cost—a fraction that of brass with finishing eliminated. Perhaps you have a similar part or component.

5 *ways to design for profit with Chicago Molded plastic parts*



4 These injection molded nylon shapes compose a unique Venturi Valve unit used to regenerate the mineral bed of a Culligan Water softener. Previously, they were brass. By switching to Chicago Molded Thermoplastics, performance and durability were improved, material cost cut, machining and finishing eliminated. Your job may be smaller or very large, may require a different plastic, compression or transfer molding. For the right combination, call CMPC.

5 This transfer molded part is one of 10 Tormat memory blocks in the Seeburg Selectomatic 200 phonograph. The Chicago Molded body involves closest tolerances at 10 key spots on each side of the blocks. Fine detail and dimensional stability, good dielectric properties and high moisture resistance were basic material requirements met by CMPC. Our engineers can suggest ways to make your products better by designing in plastics . . . *designing for profit.*

DESIGN FOR PROFIT by consulting Chicago Molded engineers before committing your product to final drawings. They can show you how to make a good product even better, at lower cost through the use of custom molded plastic parts. Contact:

CHICAGO MOLDED
PRODUCTS CORPORATION
1021 North Kolmar Avenue, Chicago 51, Illinois

THE PLASTISCOPE

(*Continued from page 39*)

than the 5000 series and present more stress crack problems; but that can be handled by uniform temperature control. Note that the resins used for detergent bottles, wire coating, filament, sheet, ribbon yarn, etc., in both the 5000 and 6000 series are still 38 cents.

The company also introduced four new resins, called special tailored resins. They are TR-101 for heavy-duty film at 40¢, which is suggested for fertilizer bags and tarpaulins. It is claimed that in a 6- or 7-mil thickness it will give the same performance as 10-mil conventional film and is competitive with multiwall bags. Chippewa and Chase Bag have reportedly used it. TR-201 is priced at 44¢—it is similar to the 5003 resin for bottles but contains anti-oxidizing agents such as carbon black and Santonox. TR-212 is a pipe resin approved by NSF, and TR-213 is a conduit resin. Both sell for 38 cents.

Effect of price reduction. Other high-density resin producers followed the Phillips reduction immediately. Conventional-resin producers who sell molding grade PE at 35¢ were inclined to ignore the price drop in high-density resin. "Let 'em fight it out among themselves" seemed to be the general attitude. Even producers of conventional PE who make a special high-melt-index resin for housewares are reconciled to a belief that high-density will probably make a big dent soon in the housewares and toy field anyhow. Furthermore, it was believed that the Phillips move was an attempt to stabilize a situation in which prices for high-density fluctuated all the way from 26 to 38 cents. Most of the material in the lower price ranges was off-grade—compounded and sold by reprocessors. The off-grade is frequently blended with conventional PE to give the molder a 0.935 to 0.940 density which in many cases gives the extra stiffness he desires. It is expected that the 35¢ price will encourage more molders to use 100% high-density in their molded items. Producers of conventional PE shouldn't worry too much about a price drop in high-density material. They are selling resin almost at a capacity level anyhow.

How to convince a housewife. Producers have had quite a time trying to convince housewives that high-density polyethylene is different from conventional PE. W. R. Grace & Co. took a dramatic step to demonstrate the difference by installing an injection machine in the housewares section of Macy's New York store and molding large size mixing bowls in front of the customers' eyes. The differences between the two types of PE were explained by voice and by sight —stiffness, luster, and boilability. Women flocked around the roped-off enclosure like ants in an ant hill; and they purchased bowls at a much faster rate than the machine could turn them out, so that supplies had to be brought in from the outside. Additional "umph" was secured by selling the bowls for 19¢ each in contrast to the regular price of 69 cents. Thus the housewives not only found a bargain but learned how to distinguish between the different kinds of polyethylene.

Polycarbonate license. General Electric Co. and Farbenfabriken Bayer of Germany have executed a cross-license agreement under U. S. patent rights of each company in the field of polycarbonate polymers. Each com- (To page 43)

The severe, ill-fitting "envelope" bathing cap of former days is outmoded. Imaginative styling has taken over, to create a crown of beauty out of new polymers.

Beauty–in and out of the swim

To achieve the cooling whites and becoming pastels the designer wants, compounders choose TITANOX® white titanium dioxide pigments. TITANOX-RA in particular has really put white and tinted stocks in the swim.

There's rutile or anatase titanium dioxide white pigment in the TITANOX line for any rubber or plastic composition. Our Technical Service Department will be happy to help you select the proper one. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities. In Canada: Canadian Titanium Pigments Limited, Montreal.

TITANIUM PIGMENT CORPORATION
SUBSIDIARY OF NATIONAL LEAD COMPANY

7129

THE PLASTISCOPE

(*Continued from page 41*)

pany developed the material independently. It is noted particularly for impact strength, dimensional stability, heat resistance, and electrical properties. More than 125 commercial applications for injection-molded products are now being supplied from G. E.'s Pittsfield, Mass. plant, where semi-works facilities have been in operation a year or more. A commercial plant for production of G. E.'s Lexan polycarbonate will be ready for operation in mid 1960.

Plastic printing plates. Du Pont has announced that seven commercial outlets are ready to produce Du Pont's Dycril photopolymer printing plates. The plates consist of a photosensitive plastic supported by a metal backing that may be flexible or rigid. A photo negative is held in contact with a blank Dycril plate and then exposed to ultra-violet which make the printing areas insoluble. The unexposed plastic is removed by a water spray leaving the printing areas in relief. A ready-to-run plate can be made from a negative in less than 20 min., according to the company. Du Pont has never announced what plastic is used in their application.

Lower-cost epoxy adhesive. A 100% reactive epoxy adhesive is now available at $8/gal. (mixed) in drum lots from Rubber & Asbestos Corp., Bloomfield, N. J. The company claims that previous adhesives of this type sold for $35 to $37 a gallon. The price is equivalent to 78¢/lb. in drums compared to previous prices of $3.50. The adhesive, Bondmaster M685, is free-flowing, intermediate strength, room-temperature curing, two-component material formulated particularly for bonding styrene foam, or other rigid foams, or most any rigid plastic to metal or other plastics. Pot life with the company's hardener CH-22 is approximately 60 to 90 min. and up to 45 min. with hardener CH-34.

More methacrylate. Du Pont has announced a 40% expansion of its methyl methacrylate monomer capacity. This follows doubled capacity in 1956 which means that capacity is three times greater than in 1955. Total U. S. capacity has been estimated at 130 to 150 million lb. before the Du Pont expansion, with Rohm & Haas, the other supplier, capable of producing 90 million or more.

Uses in 1958 are estimated to have been around 30 million for molding and extrusion, almost 40 for cast sheet and the balance for paint, lacquer, and miscellaneous, as well as 14 million exported.

Du Pont is expecting increases particularly in lacquer, methacrylate sirup for reinforced plastics, and Lucite 147, a material designed for extrusion of flat sheet. Lacquer for autos was used on only 35% of the General Motors cars in 1958, or about 4 million lb., but will reputedly be used on all of them this year. The sirup is catching on rapidly for reinforced plastics used in glazing and panels. The extrusion material, after several years of development, is now believed ready for big expansion with hopes pinned to a sheet with optical properties for such applications as signs and lighting—it is also claimed to have good solvent resistance to anti-static agents which are used in preventing dust attraction.

For additional and more detailed news see Section 2, starting on p. 236

LETTERS TO MODERN PLASTICS

Where readers may voice their opinions on any phase of the plastics industries. The editors take no responsibility for opinions expressed.

Where to get it

First of all, many thanks for so capably handling our article on "Gas transmission by plastics films," which appeared in the August issue of MODERN PLASTICS. Both Bill Sauber and I were quite pleased with the editorial treatment, the illustrations, and most of all the response we have received from your readers.

In our zealous attempts to avoid commercialism, however, I am afraid we missed an opportunity to list sources of supply for the equipment described. We understand that the Custom Scientific Instruments Co., Inc., P. O. Box 170, Kearny, N. J., has available the Dow gas transmission cell, and that the Atmosphere Control Co., Inc., 5315 Chester Ave., Philadelphia 43, Pa., is another company which can provide a similar instrument for those who are interested.

We would heartily recommend that anyone concerned with measuring fast transmission rates of plastics contact these people. We, of course, will continue our policy of referring purchase inquiries to these two manufacturers.

W. E. Brown,
Plastics Technical Service
The Dow Chemical Co.
Midland, Mich.

It's a design problem

The contribution of R. N. Hampton in "Letters to Modern Plastics," (MPl, August 1959, p. 42), points up what may be a blind spot in the thinking in the industry.

With apology for lifting a sentence out of context, the following quote illustrates what I mean: "We feel that it is of the utmost importance that the public, the appliance industry, and the Underwriters' Laboratories be fully aware of the magnitude of the task asked of the plastics industry; i.e., to produce a flameproof material which is at the same time as practical and economical as the materials now being used."

In the first place, "to produce a flameproof material which is at the same time as practical and economical as the materials now being used" is not the concern of the Underwriters' Laboratories at all. Their concern is that electrical appliances (in this case) should be safe. That it should cost more or less money or trouble to make them so is not the proper sphere of interest of Underwriters' at all.

The fallacy of the whole approach is to think we can ever make materials, which in the nature of things are combustible, by some alchemy into materials which are not combustible. It would be almost as realistic to say that we can power vehicles with internal combustion engines, but we may not carry combustible fuel on these vehicles. What we have done is to face up realistically to the fact of nature, that these fuels are highly inflammable, to design an automobile in which their use is relatively safe, and to accept fire insurance rates according to the remaining risk.

A realistic approach to this plastics flammability problem would be similar. We should first recognize that any reduction in flammability so far made or likely to be made by use of additives, etc., result in "improvements" which, while measurable by refined laboratory techniques, are made under conditions many times less severe than those encountered in a real fire, and consequently not even relevant. What is really needed is an improvement, not in degree but in magnitude.

Such improvements are not likely to be made with chemical additives in the plastic components. Such improvements may be feasible in the over-all design. In other words, the appliance, the building panel, or whatever is being designed, must be designed as an automobile is designed, recognizing that a combustible component is present and providing for it. If such designs cannot be made so as to be acceptably safe, at acceptable economy, then maybe plastics just aren't the right materials to use. So sorry!

But plastics formulators are allowing themselves to be panicked into accepting a problem which they probably won't be able to solve and which rightly belongs to design engineers and marketing people. To plead that it is an oh so difficult problem is to beg the issue.

Robert P. Courtney
Normal, Ill.

Plastics Institute proposed

Many engineers and business men are concerned with the numerous fundamental plastics problems that remain unsolved and that limit the growth of the industry. Because these basic problems are broad in character, no one organization can be expected to recover its research expense. As a result, organizations spend their money on programs that will give them a proprietary position—and the *basic* industry problems continue unsolved.

It has been proposed that all of the people concerned with the production of plastics materials and products work together in the establishment of an American Plastics Institute to do these studies for the benefit of all.

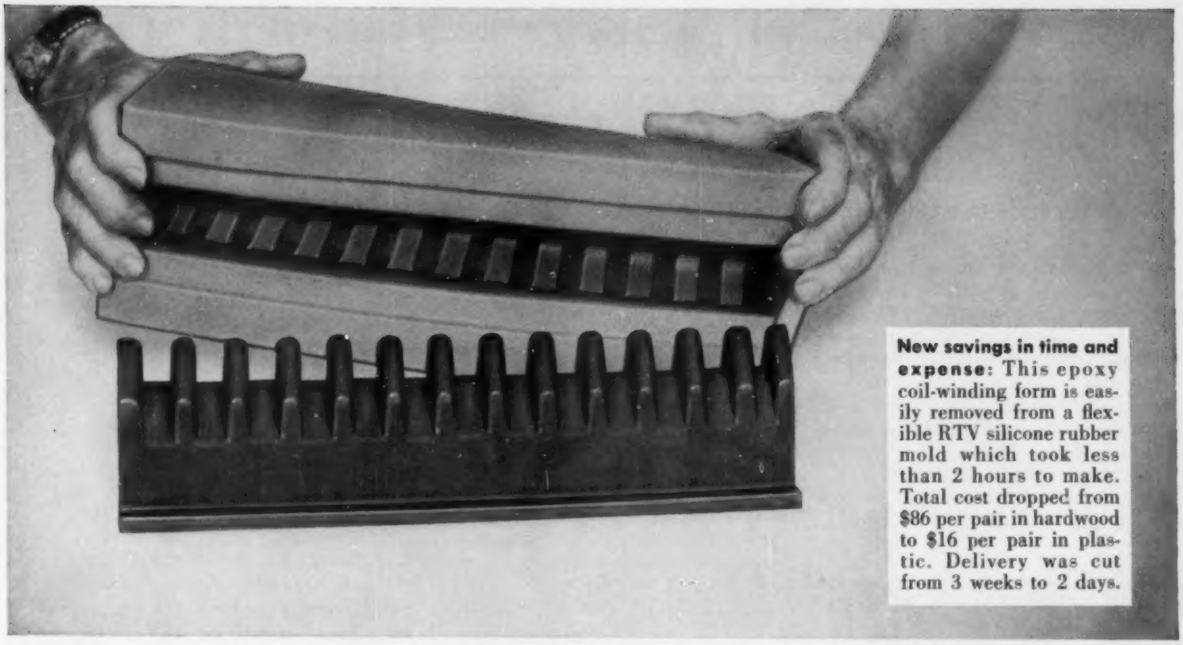
Typical of the projects that are considered suitable for study by such an organization would be work dealing with the fundamental characterization of the polymers, establishment of relationships between structure and physical behavior, fundamental studies of fabrication, mold making methods and materials with a view to reducing their time as well as their expense.

The latter is particularly relevant, since improved mold making methods can double or even triple the plastics industry.

Fundamental molding and extrusion studies, aimed at finding the most effective methods to predict the processability of the plastics, are long overdue. All known equipment for measuring the parameters of the polymers must be evaluated in order to develop the best instrumentation. Such instrumentation could take much of the guesswork out of molding and extrusion. Improved instrumentation and methods will help clarify and resolve the need for the large number of physical characteristics now cited and reduce these to more appropriate tools that may be used by the research and the production engineers.

These studies are typical of many that should be combined with advance educational programs, and the industry is late in getting together on a program that will contribute so much to its growth. Your help and suggestions are needed. Please write your views to your society or group so that consideration may be given to all views and interests.

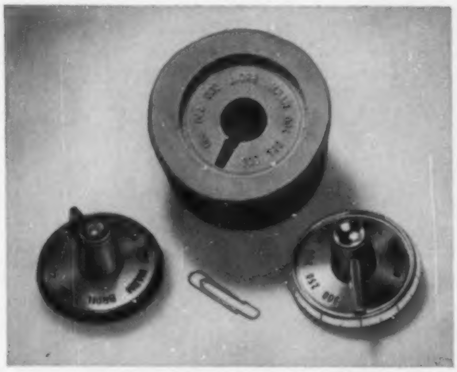
Ralph L. Mondano,
Chairman
of the Founding Committee
Raytheon Co.
Maynard, Mass.



New savings in time and expense: This epoxy coil-winding form is easily removed from a flexible RTV silicone rubber mold which took less than 2 hours to make. Total cost dropped from $86 per pair in hardwood to $16 per pair in plastic. Delivery was cut from 3 weeks to 2 days.

General Electric RTV silicone rubber opens up new fields in tooling and model making

Flexible, needs no parting agent, low shrinkage, duplicates glossy surfaces and fine detail



High-quality prototypes: RTV (room temperature vulcanizing) silicone rubber accurately reproduces surface finish and fine detail. This prototype control knob and other more complicated parts are easily removed from molds without using parting agents. Shrinkage less than 0.2%.

Precision, low-cost tooling: Previously machined from plastic laminate at a cost of $175 each, this fixture is now produced in a two-piece RTV mold at a saving of over $150 per part!

Ideal for casting fragile parts: 20 epoxy duplicates of this fragile actuator ring (.030" thick) were produced in this RTV mold. Even broken machine parts can be reassembled and used as a master to mold new parts.

For application data on RTV silicone rubber write General Electric Company, Silicone Products Dept., Section G101, Waterford, New York.

GENERAL ELECTRIC

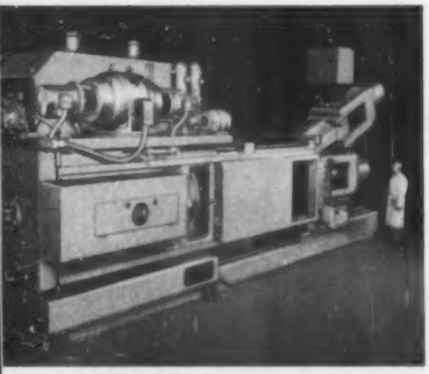
Silicone Products Dept., Waterford, N. Y.

NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Preplasticating injection press

The H-P-M Model 1000-P-200 has a rated plasticating capacity of 300 lb./hr. of GP polystyrene, with a maximum injection shot volume of 350 cu. in. Top injection ram speed is 207 in./min. or 4050 cu. in./min. Injection pressures up to 20,000 p.s.i. can be developed. Maximum mold space is 60 in. wide and 39 in. high, with daylight of 65 in. (79 in. without ejector box). Minimum mold thickness without spacer is 20 inches. Hydraulic clamping is 1000 tons capacity. Preplastication takes place in a ram-cylinder stuffer mounted above the injection cylinder. Stuffing of the injection chamber takes place during the entire cycle (except during injection) including opening and closing of the clamp. A three-way valve controls material flow between the preplasticating and injection cylinders. The usual manual and semi-automatic control is provided. Main electrical controls are separate. The machine is rated at 180 hp. and requires floor space 359 by 85 inches. *The Hydraulic Press Mfg. Co., Div. of Koehring Co., Mount Gilead, Ohio.*



H-P-M injection press continues to stuff the cylinder during the entire cycle, except during injection.

High-shear viscometer

Capillary-type viscometer, used to study the flow of polymer melts, has interchangeable capillary dies and permits a broad range of shear stresses and rates to be studied. The capillary is fed from an electrically heated, cylindrical reservoir which will hold about 25 g. of material. Test temperatures from 100 to 450° F. can be set and are maintained by a thermistor controller. Nitrogen gas pressure is used to force the material through the capillary and can be controlled over the range of 0 to 2500 p.s.i. To evaluate a particular material the cylinder is filled and allowed to reach the desired temperature. Gas pressure then forces viscous fluid through the capillary and the rate of extrusion is measured. A complete flow curve can usually be obtained from a single sample. According to the manufacturer, ASTM is now working on a standard test method for use with this instrument. *Canadian Industries, Ltd., world-wide distribution through Fischer & Porter (Canada) Ltd., 2700 Jane St., Box 135, Downsview, Ont., Canada.*

Rotary marking machine

The model 9A-14 rotary marking machine utilizes flat dies, engraved with raised lettering or design, to mark such cylindrical items as rings, rods, hand-wheels, and dials. The part, placed on a mandrel, is rotated against the die and marked by a "point of contact" method. A roll die replaces the flat die for marking flat parts. Overall size of the air-operated machine is 14 by 51 by 18 in., and it is said to be capable of producing 1500 or more marked parts per hour. It will do serial numbering and fixed marking in alternate rotations. Features of the marking machine include a gear and rack arrangement for precise control of mark length, hydraulic speed control mechanism, and a fog-type lubricator. *The Acromark Co., 5-15 Morrell St., Elizabeth, N. J.*

Reversible steel pins

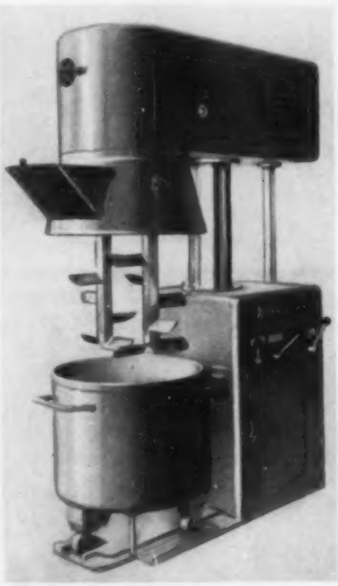
Useful as core pins, perforators, set-up pins, or gages, the De-Luxe Line offers all diameter sizes from 0.030 to 0.750 in. in increments of 0.001 in. (a total of 721 sizes), with a guaranteed tolerance of $\pm$ 0.00005 inch. Length is 2 inches. The line serves about 90% of all pin needs and can be purchased individually or in sets. Special sizes and lengths are available on request. The reversible construction enables the user to reverse the pin when worn, providing extra long life. For storage, the pins are packed and labeled in individual plastic vials with screw caps. *Dundick Tool Works, Inc., 3410 W. 31st St., Chicago 23, Ill.*

120-mc. dielectric heater

Ultra-high frequency heater operating at 120 mc. can handle non-conductive materials, such as polyethylene, as well as conductive-type materials. According to the manufacturers, one of these machines is currently being used to seal polyethylene ampules at 0.25 sec. per seal. Advantages of the machine are speed, localized heating, and its adaptability to production use, since no water cooling of the work coil is required. The units are available in 1 kw., 5 kw., and larger sizes. *Radio Frequency Co., Inc., 44-46 Park St., Medfield, Mass.*

Mixer-kneader

For processing a wide range of liquid, viscous or pasty materials, mixer-kneader uses the planetary mixing principle. Two mixing spindles, with helically oriented vanes, move around tank wall **(To page 48)**



LEHMANN mixer-kneader can handle fluid, viscous, and pasty materials.

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

Produce Plastics Profitably!

Model H-400
4-6 oz. CAPACITY

This automatic Van Dorn plasticizes 100 pounds plus per hour, has 175 tons clamping pressure, and achieves up to 840 dry cycles per hour. This press also features: Fast Mold Set Up, Four Tie Bars, Adjustable Toggle Stroke, and Maximum Operator Protection.

SELECT A VAN DORN PRESS

Model H-300 3 oz. CAPACITY

This automatic Van Dorn plasticizes 65 pounds plus per hour, has 75 tons clamping pressure, and achieves up to 1200 dry cycles per hour. This press also features: Fast Mold Set Up, Four Tie Bars, Adjustable Toggle Stroke, and Maximum Operator Protection.

BEST FOR YOUR NEEDS

Model H-260 2½ oz. CAPACITY

For greater efficiency, this automatic Van Dorn has a High Capacity Heater. The press plasticizes 30 lbs. plus per hour, has 30 tons clamping pressure, and achieves up to 720 dry cycles per hour. This press also features a Fast Mold Set Up.

Write for Detailed Information

The Van Dorn Line also includes 2 oz. and 7 oz. capacity presses, and scrap granulators.

THE VAN DORN IRON WORKS CO.
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Van Dorn
Established 1872

(From page 46)

while rotating at high speed on their own axis. The mixing mechanism moves vertically and is raised and lowered automatically. The shapes and materials of construction of the mixing tools and tanks can be varied according to the user's requirements. Swivel, tilting, runout, and stationary tanks of 1 to 350 gal. capacities can be supplied in either single wall or in double wall construction for heating or cooling. *J. M. Lehmann Co., Lyndhurst, N. J.*

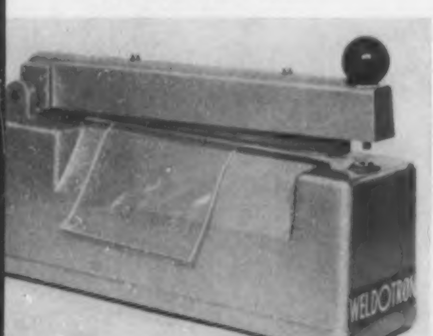
Resin dispenser

Automatic shot meter is designed to mix, meter, and automatically dispense air-free any type of flowable, two-part resin compound, adhesive, or potting material. Operated by 80 p.s.i. air pressure, the unit minimizes the flash danger from highly volatile materials. Shot measurement is adjustable by means of a simple scale in 50 increments between 2 and over 100 grams. Smaller or larger shot sizes are available by special order. Metering and dispensing is by positive displacement and can be controlled manually or automatically. Cycling rates and rates of material flow can also be controlled. There are no moving seals and a special snap-on mixing head is easily removed for cleaning. The unit is available with heated and pressurized, as well as agitated feed tanks. *Pyles Industries, Inc., 20855 Telegraph Rd., Detroit 41, Mich.*

PE bag sealer

For small lots or laboratory use, the Weldotron Sealboy polyethylene sealer has been designed for sealing small bags. The unit plugs into a standard 110 to 120 A.-C. outlet. The sealer, manually operated, is 12½ in. long by 4 in. wide and will produce seals up to and including 8 in. long. Sealing time is 0.5 to 2 sec., depending on the thickness of the film. Although the sealer is specifically designed for polyethylene films, it can also be used with other plastic films. Price: $75. *Plastic Welding Corp., 780 Frelinghuysen Ave., Newark 12, N. J.*

WELDOTRON Sealboy polyethylene bag sealer, which is used for small lots or laboratory use, plugs into an ordinary a.c. outlet.



Label printer

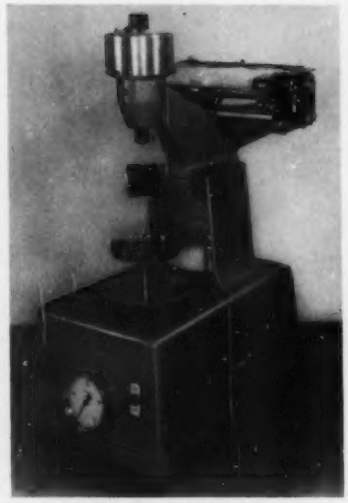
Label marker prints and die cuts pressure-sensitive label paper, or score-cuts gum, heat-seal or plain paper. The printer can be of use for in plant printing of production tags, identification tags, etc. for plastic sheets, rolls, and parts. It is 9 in. square (without guard case) and weighs 40 pounds. The unit will print colored labels of professional quality at rates up to 6000/hr. Colors and printing plates can be changed in seconds. Maximum label size is 3 by 4 in.; however, a 4- by 5-in. size can be supplied at extra cost. Price of the standard model, less accessories, is $395. *Sohn Mfg. Inc., P. O. Box 87, Plymouth 2, Wis.*

Metallizing wire

Designed for vacuum metallizing, Open Strand tungsten wire consists of three strands coiled around an aluminum wire core. As the aluminum core vaporizes and disappears in the first flash of the metallizing process space is left between the tungsten strands of the coil. According to the manufacturer, this increases the tungsten surface area by at least 25% over that in former coil designs of tightly twisted tungsten strands. The result is quicker, more even "wetting" of the coil by the melting aluminum. Also, Long Grain tungsten is used, which resists recrystallization into the ordinary short grain structure at flashing temperatures. This, combined with more even wetting is said to prevent embrittlement of the coil and to give as much as 80% more production per coil than former wires. The new aluminum core tungsten wire is available in either ready-to-use coils or random lengths in commercial quantities. *General Electric Co., Nela Park, Cleveland 12, Ohio.*

Paddle viscometer

Available with 15 paddle designs, the Visco-Corder measures viscosity of fluids, such as epoxies, gels, and plastisols. Changes in viscosity are automatically recorded and plotted. Being completely linear in response, conversions from the Brabender units to other viscosity scales are easily accomplished. Other features of the viscometer include a stepless variable speed drive (20 to 200 r.p.m.); disposable test paddles and sample containers; and interchangeable tension spring cartridges from 125 to 2000 cm.g. *C. W. Brabender Instruments, Inc., 50 E. Wesley St., South Hackensack, N. J.*



BRABENDER Visco-Corder viscometer features disposable paddles. Changes in viscosity are automatically recorded and plotted.

Foam mixing head

For use in the production of polyurethane foams (all types), the mixing head will control two or three material feed streams. A rod type valve with Teflon seals provides sharp cut-off for "on-off" operation. When mixing is not taking place, the chemical components are continuously recirculated. The mixing chamber is self-cleaning and need not be flushed with solvent between shots. However, there is an extra part provided on the chamber for solvent flushing or air control in special applications. Material throughput up to 50 lb./min. is possible with this mixing head. *The Martin Sweets Co., Inc., 114 S. First St., Louisville 2, Ky.*

Blow-molding machine

Suitable for the production of hollow plastic containers, housewares, automotive parts, and toys, Stokes Model 855 is a manifold type machine with two blow-molding stations. The manifold can be fed by any 1¾ to 3½ in. extruder. Each molding station operates independently of the other, and each has separate controls for cutting the parison, blowing air, and closing and opening the mold. Controls and interlocks (To page 50)

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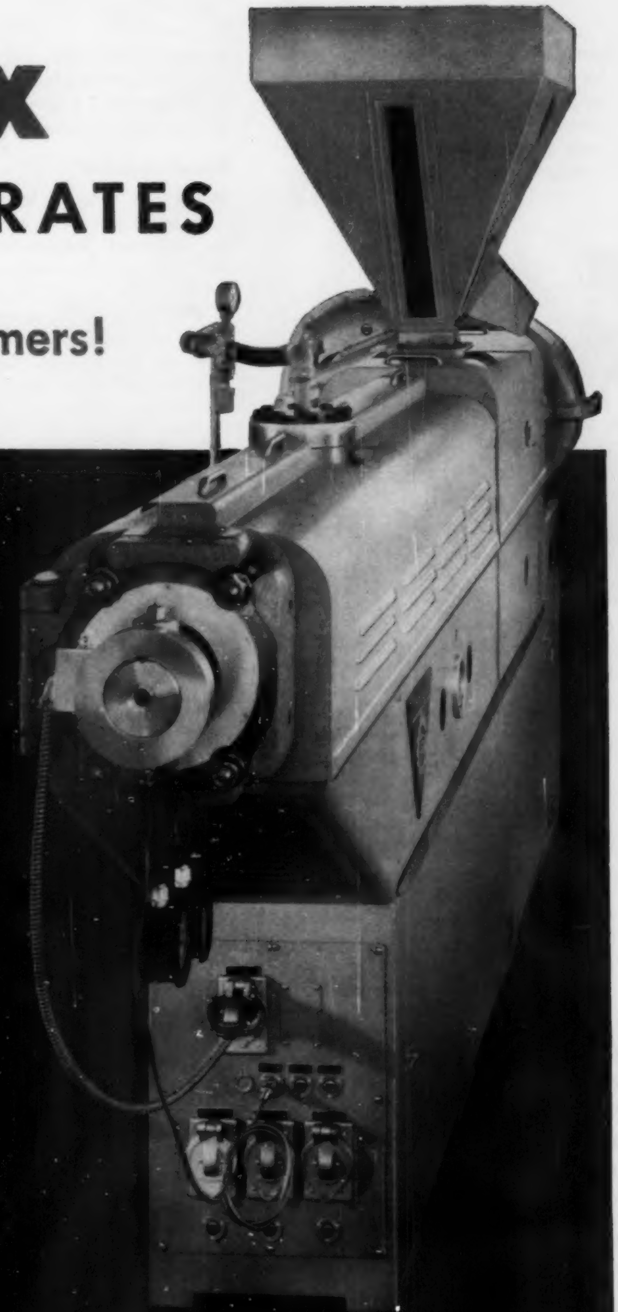
...as reported by customers!



1¾" (10 H.P.)	lbs/hr.
Vinyl tubing from dryblend	120
Linear Polyethylene monofilament	100
Polyethylene blown bottles	110
2½" (20 H.P.)	
ABS Sheet, vented	200
Rigid vinyl pipe from dryblend	170
Polyethylene on cellophane	170
3½" (40 H.P.)	
Vinyl garden hose	480
Polyethylene pipe	380
Roll cast polypropylene film	370
4½" (60 H.P.)	
High impact polystyrene sheet, vented	670
Cellulose butyrate sheet, vented	640
Vinyl coated on wire	690

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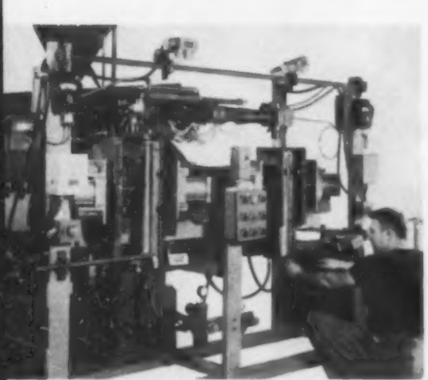
NEW MACHINERY-EQUIPMENT

(From page 48)

permit the unit to be adjusted for either fully automatic, semi-automatic, or manual operation while running either mold separately, or both simultaneously. Up to 1 ton of mold clamping pressure is provided



STOKES 855 blow molding machine can handle molds up to 24 in. long.

by each of two 5-in. horizontal air cylinders, each having a 4-in. stroke. Molds up to 24 in. long can be centered in the platens which are 8 in. wide by 18 in. long; daylight (mold open) is 18 inches. Two identical or two different molds can be run at the same time by a single operator. The machine requires an air supply of 5 hp. at 100 p.s.i. and 110- and 220-v. 60-cycle A.-C. supplies for heaters and controls respectively. The machine measures 102 in. long by 36 in. wide by 68 in. high. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Boring tool

Introduced two years ago as an improved tool for producing accurately round, undistorted, and burr-free holes in extremely thin plastics, fibers, other materials, the Roto-Bor is now available in a new design that is equally efficient on heavy gages. In addition, the new unit has been successfully utilized in producing accurate holes in cylindrical and spherical parts, including both tubing and pipe. The boring tool's patented axially retracting center point assures accurate positioning and eliminates the necessity of center punching or pilot drilling. Stock sizes are available from 3/16 in. to 2 1/32 in. in increments of 1/64 in. and with either straight or morse taper shanks. Larger sizes and specials for individualized applications are made to order. *Jancy Engineering Co., 508 S. Pine St., Davenport, Iowa.*

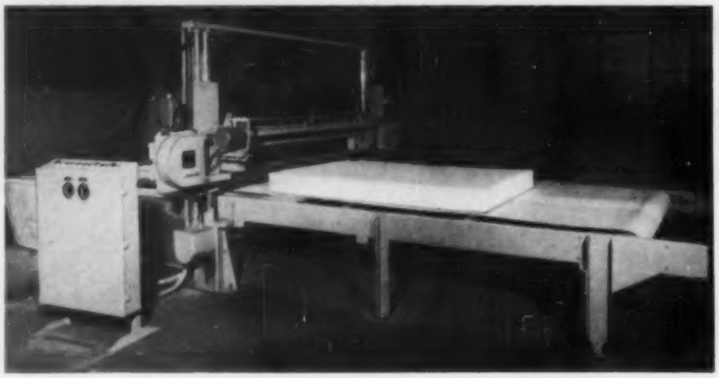
Glass chopper

Model HM chopper is designed for one-hand application of glass roving in reinforced plastics molding. The unit will supply rovings in varying lengths from ½ to 4 in., at rates up to 4 lb./min. It has a vane type air motor and operates on air pressures from 40 to 120 p.s.i. Standard injector type razor blades are used against an adjustable, gear driven back-up roller. An independent pressure roller positively prevents the roving from falling out of the chopper when operations are halted. Cutter blades are retained in individual slots in the cutter roller and may be removed and replaced readily after the housing plate and blade-retainer plates are removed. Weight of the chopper is 4 pounds. *Gaymond Co., P. O. Box 19497, Houston 24, Texas.*

Conveyorized slab cutter

Femco cutter automatically levels and splits big, bulk-produced, untrimmed blocks and long slabs of polyurethane foam into thin sheets and converts long slabs into roll stock down to ⅛-in. thick. Blocks can be split into 3 and 4 in. thicknesses without a "flip up" at the end of the cut because of a variable-speed, power-driven, input compression roll and a newly designed guide bar. Some of the other features include a motorized dual spindle blade sharpener; 30-in. vertical cutting head travel; automatic indexing of the splitting head in 1/64-in. steps; a horizontally adjustable compression roll for thick cuts; and a conveyor belt with variable speed control from 25 to 100 ft./min. on the cutting stroke and double this rate on the return. The machine is also built for continuous, heavy-duty operation. Dimensions are 20 ft. long by 80 in. wide. *The Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio.*

FALLS slab cutter will cut 3- and 4-in. thicknesses without flip-up at end of cut. Machine is built for continuous, heavy-duty operation.



Extrusion pressure sensor

Designated Dynisco Model PT58 pressure transducer, the element makes use of a strain gage to detect changes in extruder melt pressure. The instrument can be used to either monitor or control the extrusion process. The transducer, which has fast response and high resolution, will measure small and rapid pressure fluctuations in the plastic melt during extrusion. Units can be supplied to measure pressures in the ranges of 0 to 1000 p.s.i. and 0 to 10,000 p.s.i.; the maximum diaphragm operating temperature is 750° F. A water cooling jacket is supplied with the element to protect the strain gage and is so located to avoid solidification of melt on the sensing surface. Two stem lengths, 6¼ and 7¾ in. are available; both can be mounted in a standard ½-20 NF threaded fitting. *Dynamic Instrument Co., Inc., 42 Carleton St., Cambridge 42, Mass.*—**End**

DYNISCO Model PT58 extrusion pressure transducers are available with either short or long stems.

FOR THE CONSUMER

- resists stains of grease, oil and household chemicals
- offers dimensional stability
- easy to clean and maintain
- good indentation properties
- enduring beauty

FOR THE MANUFACTURER

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WORLD-WIDE PLASTICS DIGEST

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Polyethylene grabs more markets. Chem. Eng. News 37, 23 (June 29, 1959). The amount of polyethylene film, particularly in packaging, is increasing. The outlook for polypropylene film is indeterminate.

Plaudits for plastics wraps. Chem. Week 84, 28 (Apr. 25, 1959). Properties of polyethylene film and cellophane are compared for various packaging applications.

Plastisol propellant unveiled. Chem. Eng. News 37, 22-23 (July 27, 1959). A solid propellant is a plastisol composed of polyvinyl chloride, a plasticizer, ammonium perchlorate, and aluminum powder.

Materials

Semiconducting adsorbent debuts. Chem. Eng. News 37, 30 (June 29, 1959). A new polymer, polymerized xanthene, is a semiconductor.

A new adhesive extender based on rice husks. D. Narayanamurti and R. C. Kohli. Kunststoffe 49, 269-70 (June 1959). The utilization of agricultural and forest wastes is discussed with special reference to rice husks. Ground rice husk is used as a filler for phenolic resin wood adhesives and results in considerable saving. After alkali decomposition the residue consists mainly of cellulose, proteins, and pentosans, and may, after adding 9 to 12% phenolic resin, be used for making hardboard. The extract is acidified to form a gel which is an excellent extender for phenolic casein and animal adhesives. An attempt is made to explain the reaction mechanism of these gels.

New high impact vinyl polymer. Rubber and Plastics Age 40, 431 (May 1959). Properties and applications of a high impact plastic composed of a mixture of polyvinyl chloride and a chlorinated polyolefin are reported.

Radiation polymerization makes stronger polystyrene. E. L. Colichman and R. F. Fish. Nucleonics 15, No. 10, 134-7 (1957). Copolymerization of styrene with 0 to 10% divinylbenzene by exposure to 10 to 40 megaroentgens of gamma rays gave products with Barcol hardnesses to 31, tensile strengths to 1000 p.s.i., maximum elongations up to 14%, and deflection temperatures up to temperatures of 85° C.

New epoxy molding materials. M. W. Riley. Materials in Design Eng. 49, 69-73 (June 1959). General purpose epoxy compounds contain inert mineral fillers; high impact grades are reinforced either with chopped glass or synthetic fibers. Because of their high price, epoxies will probably be used only where their combination of high dielectric properties, dimensional stability, and extremely low moisture absorption is critical. They now contain mold release agents in the resin, eliminating the stickiness problem. Cure times are equivalent to those required for phenolic molding compounds. From the property standpoint epoxy molding compounds are probably most competitive with the diallyl phthalate and silicone molding compounds. Mechanical properties are given in tabular and graph form.

Molding and fabricating

Stretching and shrinkage of PVC film. H. Haldenwanger. Kunststoffe 49, 270-74 (June 1959). During the manufacture and processing of thermoplastic film and sheeting, the material is subjected to a certain amount of stretching which will ultimately result in varying degrees of shrinkage, depending upon the grade of material, temperature, and other factors. Measurement of rebound due to influence of temperature and time, taking place after deformation, gives an insight into the regularity with which these phenomena occur, and this measurement also indicates which outside influences lead to later, undesirable dimensional changes.

Instrumentation progress in use of industrial radio isotopes. L. Walter. Rubber and Plastics Age 39, 1070-71 (Dec. 1958). The uses of nucleonic measuring and controlling equipment in extrusion are described.

How to use mechanical fasteners with reinforced plastics. M. D. Weiss. Materials in Design Eng. 49, 84-87 (June 1959). The principal mechanical fasteners used with reinforced plastics are bolts, rivets, and screws. Low ductility of the plastics will cause local stress concentrations and result in unequal load distribution. A bolt-and-nut design must give consideration to the assembly stresses set up in the fasteners as well as to the expected service loads. Rivet joints should be designed so that the rivets are not in tension. Quick-release fasteners are most valuable in applications requiring frequent assembly or removal of covers. The size of the hole, the spacing, and other design criteria are discussed for the various fasteners described.

Automatic ejection from ejector plate of injection molding machines. H. Gastrow. Kunststoffe 49, 300-02 (June 1959). The lower part of a nozzle with offset walls easily separates from the core when the ejector plate is pushed forward, but there is a tendency for it to adhere to the external contours of the ejector plate. A fully automatic method is described whereby complete ejection is effected. This has proved successful in practice and is independent of any spring loaded catches which as a rule are adversely affected by high ejection forces.

Flow irregularities in the extrusion of polyethylene melts. H. Schott and W. S. Kaghan. Ind. Eng. Chem. 51, 844-46 (July 1959). When molten polyethylene is extruded at high throughput rates, irregularities develop in the flow pattern and in the extrudate. A commercial screw extruder and special dies were used to observe these irregularities visually and by high speed motion pictures. Factors which promote the occurrence of the irregularities were studied quantitatively: sudden contractions near the die inlet, low melt temperatures, and high shear rates. These data aid in predicting conditions leading to uneven extrudates and in avoiding them through the use of improved die design and more suitable operating conditions.

Applications

"Zytel" spur gears. K. W. Hall and H. H. Alvord. Mech. Eng. 81, 50-53 (May 1959). A method of calculating the load-carrying capacity of nylon spur gears has been developed to establish reliable design methods for gears of this material. Design recommendations based **(To page 54)**

PLASTICS DIGEST

(From page 52)

on test experience are included and the use of a helicalgear speed reducer is described.

Applications of plastics materials in prefabricated buildings. T. Bianchi. Poliplasti 7, 16-23 (Mar.-Apr. 1959). Applications of plastics in buildings in Italy are described.

PVC pressure piping comes of age. F. J. Staudt. Chem. Eng. 66, 115-16 (June 1, 1959). Problems that have been solved by the thermoplastic industry for polyvinyl chloride (PVC) pressure piping are described. There are two techniques for piping assembly. One relies on interference between the pipe and the socket, using thin unfilled solvent cements to soften the mating surfaces during assembly. The other permits essentially no interference between socket and pipe, using filled solvent cements. The latter method permits dry assembly, while the former is limited to pipe sizes less than 2 inches. In the last two years, a performance test has aided evaluation of the deleterious effect of other resins compounded with PVC.

High-speed bookbinding. Adhesives Age 2, 39-42 (July 1959). The bookbinding process, utilizing adhesives, is described.

Protective coatings for missile printed circuits. A. E. Hawley and W. E. Weber. Electrical Mfg. 63, 58-62 (June 1959). Polyamide-epoxy systems, isocyanate resins, and silicones were investigated as protective coatings for missile electronic systems. Investigated were viscosity and pot life, solvent entrapment, insulation resistance, and thermal properties. An improved epoxy printed-circuit coating was developed. The coating has a relatively long pot life, low viscosity, excellent thermal and electrical characteristics, and can be cured in 2 hr. at 85° C. A silicone coating was developed which can be cured at 85° C. in 2 hr. and withstands temperatures as high as 250° C.

Properties

Shrinkage and post-shrinkage of melamine molding compounds. W. Bauer and W. Gruber. Kunststoffe 49, 297-300 (June 1959). Aminoplastic molding compounds in general, and melamine compounds in particular, show special characteristics in their shrinkage and post-shrinkage behavior compared with phenolic materials. By means of a special apparatus it is possible to analyze quantitatively these characteristic differences in shrinkage behavior between melamine and phenolic compounds. A basic idea regarding the post-shrinkage behavior of melamine compounds is developed in the article.

Infra-red spectra of polyvinylidene chloride and polyvinyl chloride. S. Narita, S. Ichinohe, and S. Enomoto. J. Polymer Sci. 37, 251-94 (May 1959). Bands are assigned to the infra-red spectra of polyvinylidene chloride and PVC, including the deuterated polymers.

Generation of static charge on high polymer. S. Kittaka. J. Phys. Soc. Japan 14, 532-38 (Apr. 1959). The generation of static electricity by the contact and separation between high polymer substances and metals was studied. The couples of polystyrene-platinum (Pt), Acrylite (polymethyl methacrylate)-Pt, and Teflon (polytetrafluoroethylene)-Pt were examined. It was observed that the surrounding conditions have serious effects on the quantity and sign of generated static charge. The mechanism of generation of electrostatic charge is proposed, assuming values for the energy levels of the localized electrons on the surface of high polymer substances and the change of these energy levels by the absorption of a number of different gases. It is estimated that work functions of polystyrene, Acrylite, and Teflon are 5.74, 5.48, and 6.04 electron-volts, respectively.

Long-term behavior of polyethylene and PVC pipes. H. Niklas and K. Eifflaender. Kunststoffe 49, 109-13 (Mar. 1959). Long-term tests carried out on normal and low pressure polyethylene pipes gave results which, when plotted as log-log functions, produced curves that were very similar to one another, decrease in mechanical strength being gradual at first but later decreasing rapidly. The change in the curve from a fairly straight line to a steep one is due to fracture with deformation developing into a brittle fracture. Long-term curves for rigid PVC were found to include straight ones as well as curves which sloped downwards or were bent. Change of the curve from straight to sloping is not in this case caused by a change in the type of fracture mentioned above, but is due to a change in the characteristics of the material, which is caused by prolonged contact with substances such as water and other similar fluids.

Gas and vapor permeability of plastic films and coated papers vs. effect of crystallinity. A. W. Myers, C. E. Rogers, V. Stannett, and M. Szwarc. Tappi 41, 716-20 (1958). The effect of the degree of crystallinity on the gas and vapor permeability of plastics films was studied, with special reference to polyethylene. Permeability decreased with increasing crystallinity. Several explanations are proposed.

New method of fractionating high polymers. F. W. Peaker and J. C. Robb. Nature 182, 1951 (1958). Polystyrene was fractionated by a zone-melting procedure in a column of molten purified naphthalene. The molecular weight distribution in each fraction was established qualitatively by turbidimetric titration.

Long-term tests on normal polyethylene pipes. J. H. Gisolf and H. van Goudoever. Kunststoffe 49, 264-68 (June 1959). A method is described whereby brittle failure may be induced in polyethylene pipes within a very short time. The pipes are exposed to pressure at room temperature, with simultaneously applied axial stress. Theoretical views on the acceleration of these fracture mechanisms are confirmed by experimental results.

Influence of current additives on the behavior of PVC under ionizing radiation. C. Wippler. Rev. Gen. du Caout. 36, 369-72 (Mar. 1959). Polyvinyl chloride (PVC) samples containing various thermal stabilizers and plasticizers were irradiated at rates varying from 1 to 100 MR. PVC samples containing stearate and diphenylthiourea stabilizers were crosslinked and were less affected than samples containing organo-tin stabilizers. The latter samples were not crosslinked. Plasticized samples were less discolored by radiation than rigid samples, but the changes in mechanical properties due to irradiation were more apparent in plasticized samples. Swelling in a solvent lightens radiation-induced discolorations, but it is reported that the same shade of color returns when the solvent is extracted.

Effect of antioxidants on polyethylene. S. Okamoto and K. Takeuchi. Bull. Chem. Soc. Japan 32, 310-11 (March 1959). **(To page 186)**

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

U. S. Pats., June 2, 1959

Plasticized polyvinyl chloride. J. Dazzi (to Monsanto). 2,889,300-302.

Polyacrylonitrile composition. H. D. DeWitt (to Chemstrand). 2,889,303.

Vinyl chloride-octylacrylate interpolymers. H. A. Fedderson (to Union Carbide). 2,889,308.

Film-forming vinyl ether polymers. H. M. Teeter, W. J. Schneider, and L. E. Gast (to U. S.). 2,889,309.

Methacrylate polymers. V. D. Tughan (to Imperial Chemical). 2,889,310.

Styrene polymers. E. C. Chapin and R. I. Longley, Jr. (to Monsanto). 2,889,311.

Alkyd resins. A. Szayna (to U. S. Rubber). 2,889,312.

Diene elastomer and halogenated cross-linking agent. T. M. Patrick, Jr. (to Monsanto). 2,889,313.

U. S. Pats., June 9, 1959

Rubber-lignin coprecipitates. H. E. Haxo, Jr. and G. S. Mills (to U. S. Rubber). 2,890,183.

Epoxy resin composition. W. Foerster (to Reichhold). 2,890,184.

Modified alkyd resin. J. H. Sample and C. H. Williams (to Sherwin-Williams). 2,890,185-6.

Cured polypropylene. L. W. Bowman, R. F. Leary, and W. J. G. McCulloch (to Esso). 2,890,187.

Siloxane elastomers. G. M. Konkle, J. A. McHard, and K. E. Polmanteer (to Dow Corning). 2,890,188.

Alkali-soluble polyesters. S. C. Greenlee (to S. C. Johnson). 2,890,189.

Polyvinyl chloride resin-urea-clay composition. R. Van Volkenburgh (to J. M. Huber). 2,890,190.

Polyester resins. W. B. Hardy (to American Cyanamid). 2,890,193.

Compositions of epoxides. B. Phillips, F. C. Frostick, Jr., C. W. McGary, Jr., and C. T. Patrick (to Union Carbide). 2,890,194-197.

Aryloxy acid urethane. A. W. Breiner (to S. C. Johnson). 2,890,198.

Polymerization employing polyvinyl pyrrolidone. D. G. McNulty and R. I. Leininger (to Diamond Alkali). 2,890,199.

Chloroethylene polymers. R. L. Hudson (to Dow). 2,890,200.

Polyvinyl chloride. W. B. Hardy (to American Cyanamid). 2,890,201.

Acrylate esters of epoxy resins. E. E. Parker (to Pittsburgh Plate). 2,890,202.

Alkali soluble resins. S. O. Greenlee (to S. C. Johnson). 2,890,203.

Epoxy resin. J. Delmonte (to Furane Plastics). 2,890,204.

Polyesters. W. H. Vinton (to Du Pont). 2,890,205.

Maleimide polymers. E. A. Kraiman (to Union Carbide). 2,890,206-7.

Lactone polymers. D. M. Young, F. Hostettler, and C. F. Horn (to Union Carbide). 2,890,208.

Epoxy resin. B. Phillips, F. C. Frostick, Jr., C. W. McGary, Jr., and C. T. Patrick, Jr. (to Union Carbide). 2,890,209-10.

Polyvinyl chloride. D. E. Lintala (to Wingfoot). 2,890,211.

Polymerization of olefins. P. B. Murray (to Sun Oil). 2,890,212.

Polyethylene chlorination. H. Noeske (to Ruhrchemie). 2,890,213.

Polyethylene. E. N. Brightbill and K. P. Lindland (to Du Pont). 2,890,214.

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Phenolic resin modified with polyvinyl alcohol. J. Fantl, F. J. Lection, and S. H. Rider (to Monsanto). 2,890,948.

Cation-exchange resins. Y. Tsunoda and M. Seko (to Asahi). 2,891,014-5.

Butadiene-styrene. R. Kern and W. N. Grohs (to Rhein-Chemie). 2,891,016-7.

Graft copolymers of polystyrene. J. J. Millane (to Distillers). 2,891,018.

Alkyl phenol-formaldehyde resin. D. Aelony (to General Mills). 2,891,-021-2.

Amino polyamides. D. E. Peerman and D. E. Floyd (to General Mills). 2,891,023.

Methylolated resins in emulsion polymerization. S. T. Putnam (to Hercules). 2,891,024.

Acrylonitrile quaternary imidazolium compound. J. A. Price (to American Cyanamid). 2,891,025.

Composition of a glycidyl polyether and a glycidyl ether of a phenol. D. Wasserman (to Minnesota Mining). 2,891,026.

Destaticized vinylidene polymers. M. A. Coler and A. S. Louis. 2,891,-027-32.

Reaction product of a polyester and a polyepoxide. W. Fisch (to Ciba). 2,891,034.

Acrylonitrile - methyl acrylate - methyl vinylidine terpolymer. J. A. Price and J. J. Padbury (to American Cyanamid). 2,891,035.

Polyethylene compositions. C. L. Stacy, Jr. and R. F. Monroe (to Dow). 2,891,036.

Allyl alcohol copolymers. R. H. Reinhard (to Monsanto). 2,891,037.

Pyrrolidone polymerization. C. E. Barnes, W. O. Ney, and W. R. Nummey (to General Aniline). 2,891,038.

Diolefin terpolymers. G. Kolb and W. Becker (to Bayer). 2,891,039.

Ethylene polymerization. W. J. Linn (to Du Pont). 2,891,040.

Ethylene polymerization. A. S. Matlack (to Hercules). 2,891,041-44.

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Chlorinated elastomeric polymers. I. Kuntz, E. J. Inchalik, and T. P. Lemiszka (to Esso). 2,891,595.

Antistatic coatings. R. J. Chamberlain (to American Cyanamid). 2,-891,878.

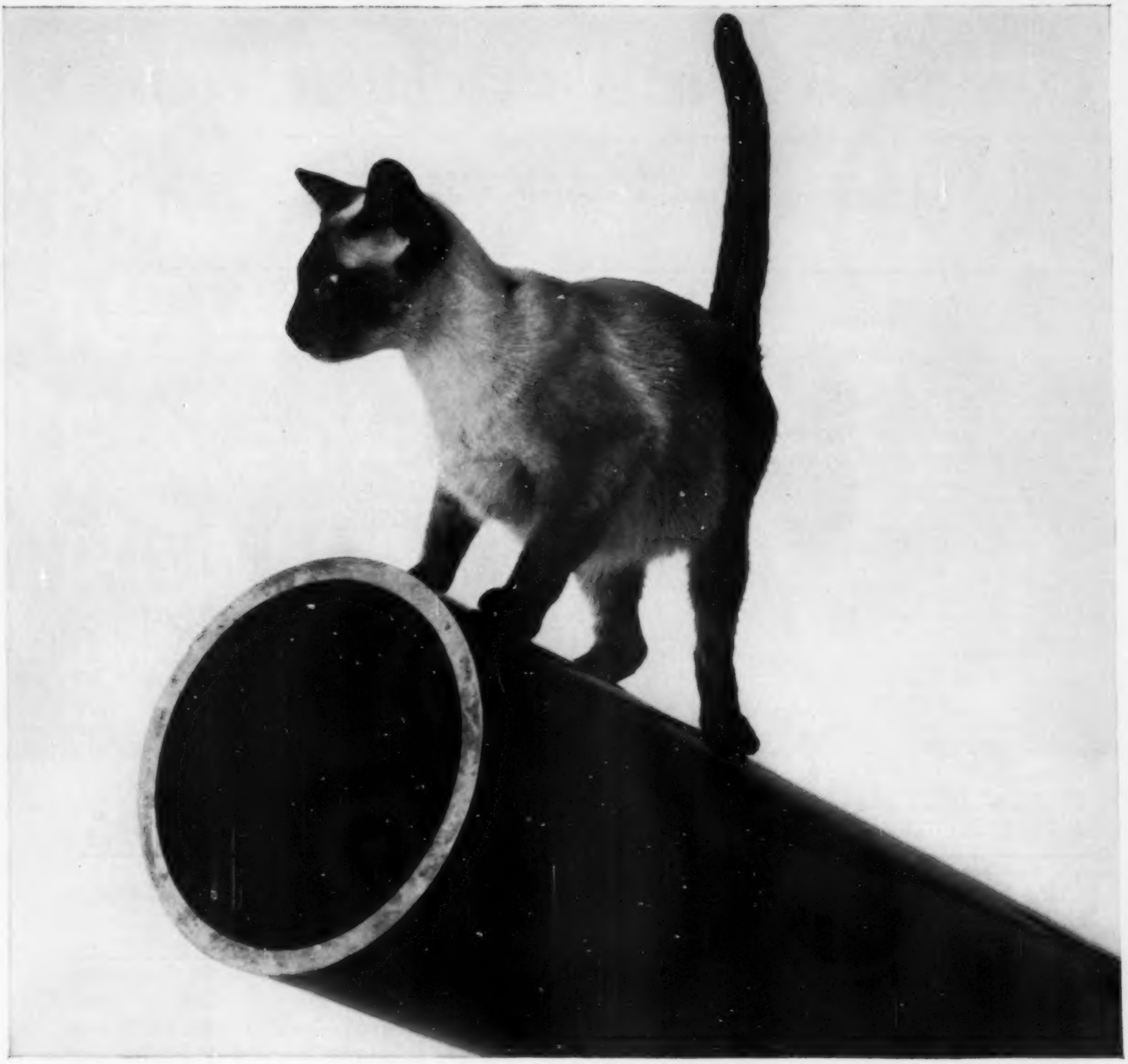
Organophosphorus polymers. W. B. McCormack and H. E. Schroeder (to Du Pont). 2,891,915.

Thiol-containing ion-exchange resins. J. C. H. Hwa (to Rohm & Haas). 2,891,916.

Sulfite liquor base resin. C. Uschmann. 2,891,918.

Polymerization of organopolysiloxanes. J. F. Hyde and J. R. Wehrly (to Dow Corning). 2,891,920.

Magnesium-iodine catalysts for polyester preparation. **(To page 193)**

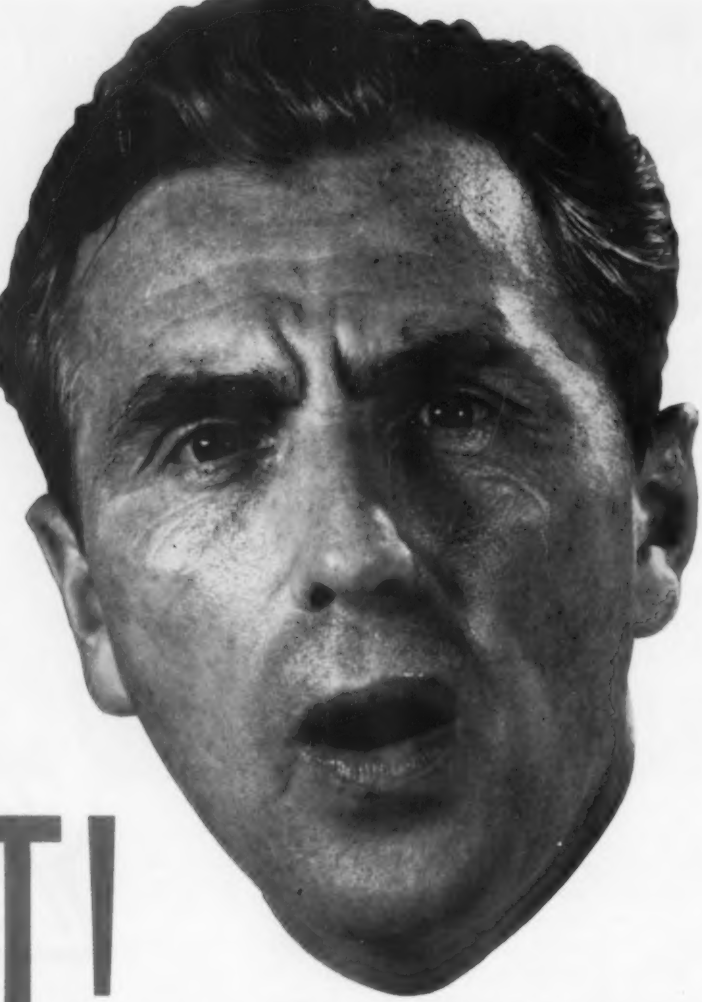


U.S. PLASTICS PRODUCTION

Production and sales figures in 1000 lb.* for the first 6 months of 1958 and 1959. From statistics compiled by the U. S. Tariff Commission.

Materials	First 6 months 1958		First 6 months 1959†	
	Production	Sales	Production	Sales
Cellulose plastics:[a]				
Cellulose acetate and mixed ester:				
Sheet, under 0.003 gage	8,607	8,527	9,171	9,326
Sheet, 0.003 gage and over	9,177	8,301	10,863	9,838
All other sheets, rods, tubes (including other cellulose plastics)	4,319	3,848	4,653	4,880
Molding, extrusion materials (including other cellulose plastics)	39,970	39,120	51,703	49,371
Nitrocellulose sheets, rods, tubes	1,622	1,760	1,808	1,147
Other cellulose plastics[g]	3,056	2,209	—	—
Phenolic and other tar-acid resins:				
Molding materials[a]	77,392	71,903	109,388	103,570
Bonding and adhesive resins for:				
Laminating (except plywood)	28,568	18,552	37,813	24,441
Coated and bonded abrasives	6,183	5,123	8,260	7,473
Friction materials (brake linings, clutch facings, etc.)	5,878	5,107	8,247	7,015
Thermal insulation	21,952	21,440	26,011	25,532
Plywood	23,598	19,872	29,053	23,953
All other bonding uses	17,930	17,816	31,539	30,685
Protective coating resins	13,751	11,897	14,859	11,925
Resins for all other uses	13,926	10,641	21,332	19,283
Urea and melamine resins:				
Textile-treating resins	16,508	15,440	17,462	17,015
Paper-treating resins	12,605	10,700	15,154	13,076
Bonding and adhesive resins for:				
Laminating[h]	—	—	17,835	13,637
Plywood	42,324	43,312	60,878	59,918
All other bonding and adhesive uses	20,004	17,684	9,776	9,607
Protective-coating resins	13,741	10,961	18,668	14,143
Resins for all other uses, including molding	46,464	43,183	61,717	59,688
Styrene resins total:	**318,570**	**317,732**	**452,772**	**418,891**
Straight polystyrene	—	—	136,687	120,521
All other	—	—	173,028	151,311
Protective coatings	—	—	41,369	37,895
Textile and paper treating	—	—	27,530	22,727
All other uses	—	—	74,158	86,437
Vinyl resins, total[b]	**358,972**	**357,122**	**548,317**	**530,197**
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:				
Film (resin content)		35,246		40,445
Sheeting (resin content)		28,469		58,560
Molding and extrusion (resin content)		93,476		149,131
Textile and paper treating and coating (resin content)[c]		26,478		34,353
Flooring (resin content)		53,285		76,383
Protective coatings (resin content)[i]		14,557		15,550
All other uses (resin content)		26,026		45,751
All other vinyl resins for:				
Adhesives (resin content)		22,332		27,457
Protective coatings (resin content)[i]		—		16,234
All other uses (resin content)		57,253		66,333
Coumarone-indene and petroleum polymer resins	**111,778**	**110,194**	**129,027**	**129,327**
Polyester resins:				
For reinforced plastics	50,165	45,612	68,847	62,921
For all other uses	5,492	5,086	11,129	10,510
Polyethylene resins total:	**410,288**	**374,437**	**562,649**	**537,158**
For film and sheeting		—		181,831
Molding materials		—		96,496
Extrusion materials		—		55,112
For all other uses		—		203,717
Epoxy resins, total:[j]	—	—	**26,531**	**21,455**
For protective coatings	—	—		9,761
For all other uses	—	—		11,694
Miscellaneous synthetic plastics and resin materials, including silicone resins[d, e, f]	**96,167**	**83,826**	**120,846**	**104,527**

*Dry basis designated unless otherwise specified. †Partially estimated. [a]Includes fillers, plasticizers and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for acrylic, and other protective-coating resins. [f]Includes data for acrylic rosin modifications, nylon silicone, and other plastics and resins for miscellaneous uses. [g]This classification discontinued in May 1958 and this material, mostly ethyl cellulose, reported in sheets and molding material. [h]Included in "All other bonding uses" in 1958. [i]Included in "All other uses (resin content)" in 1958. [j]Included in "Miscellaneous" in 1958.



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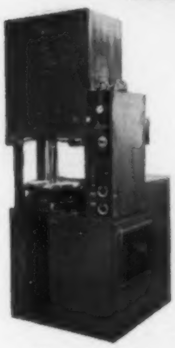

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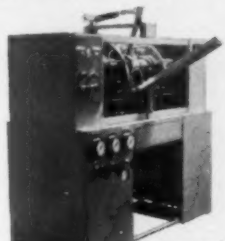
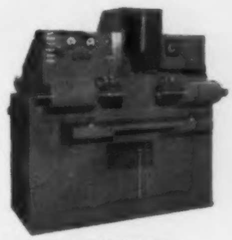


Rotary Sealer
with automatic feed



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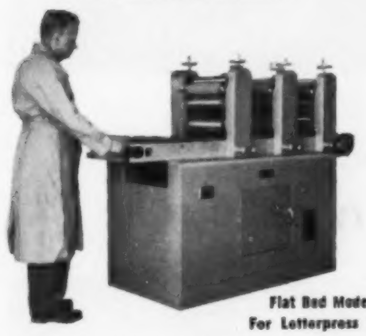

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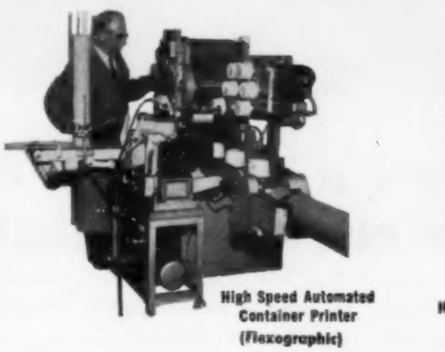

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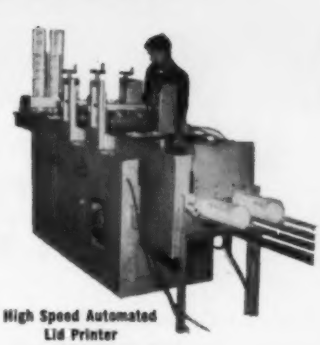

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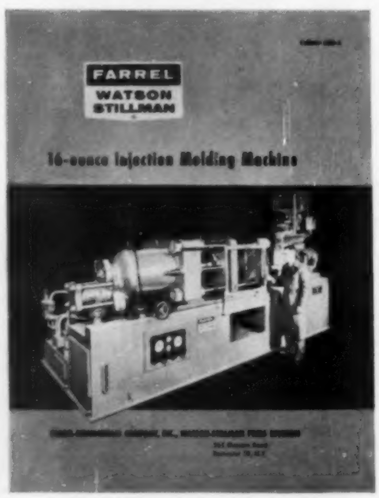

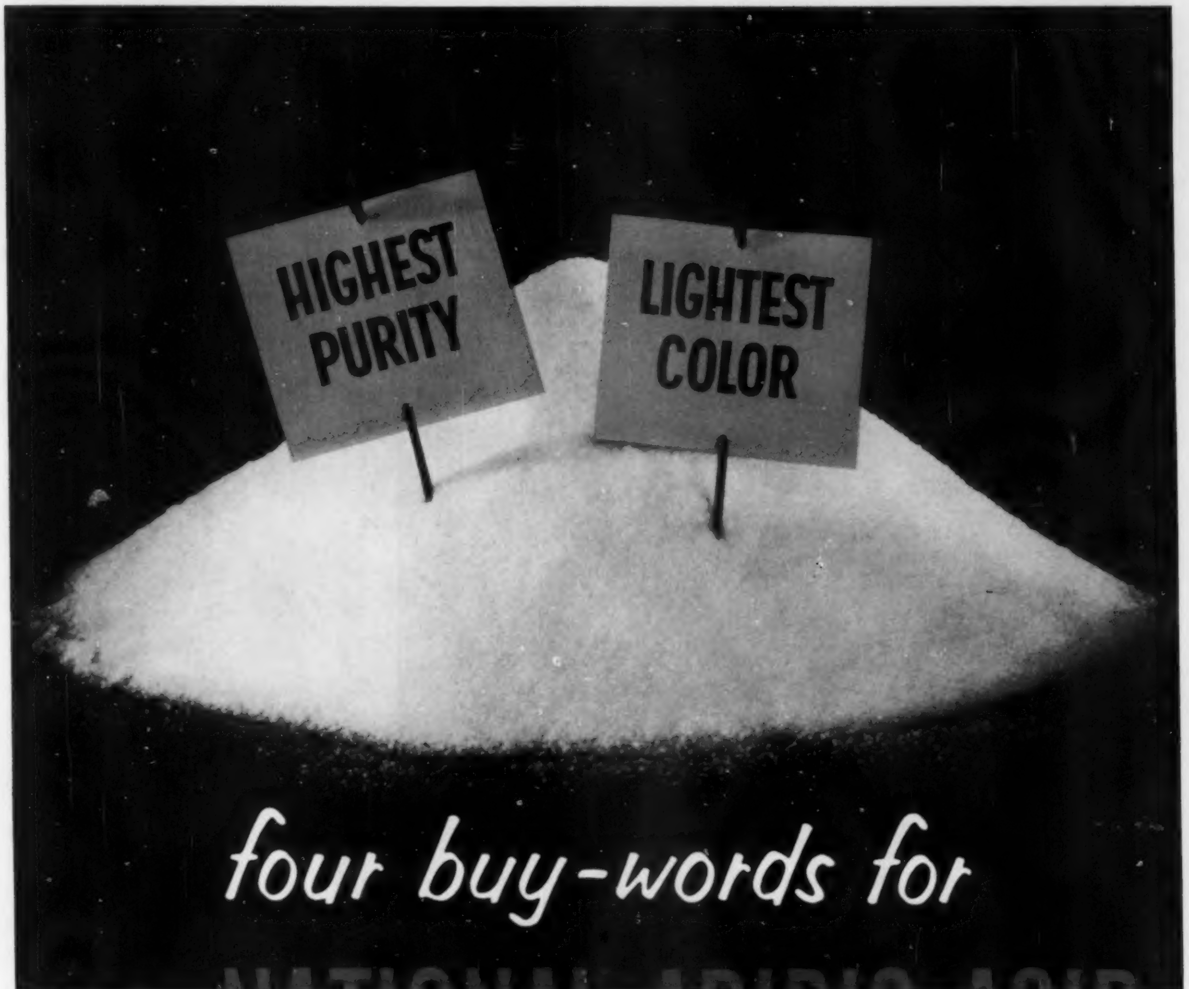

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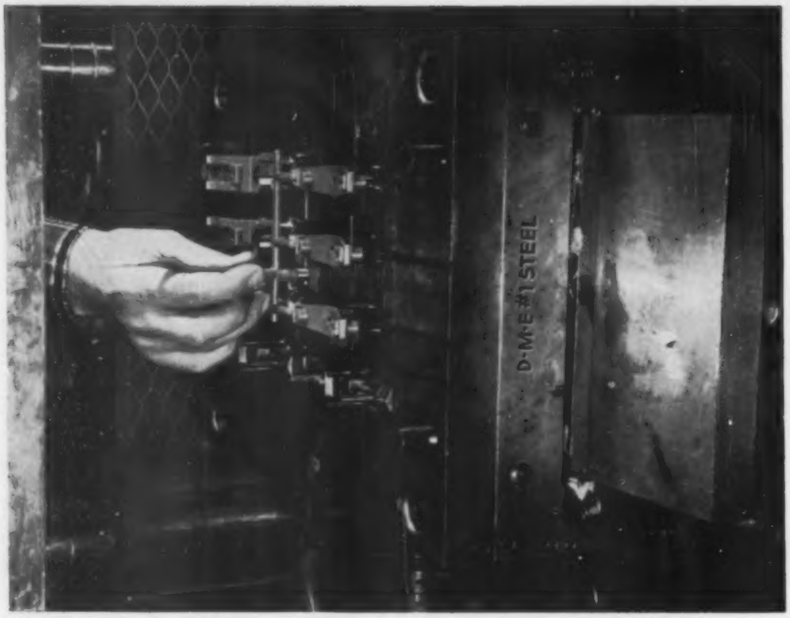

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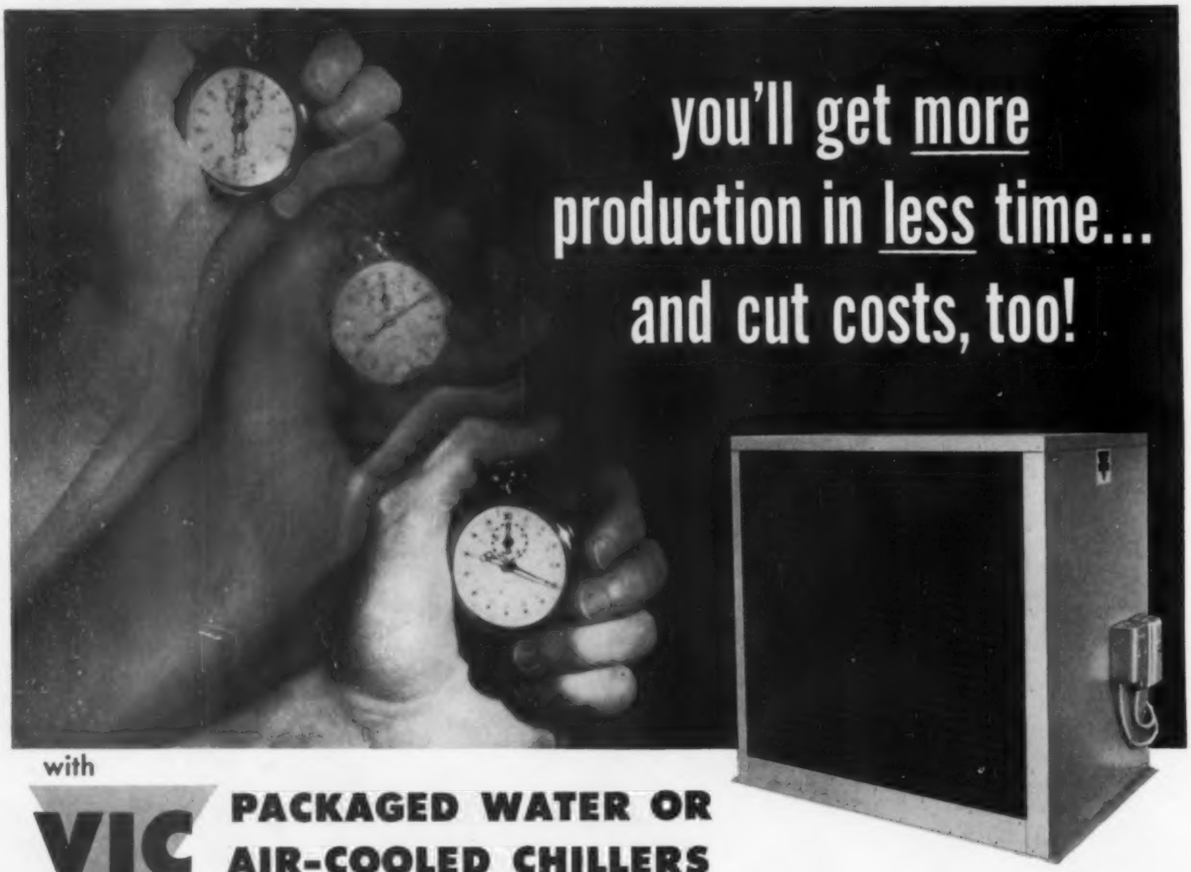

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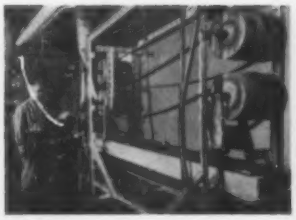

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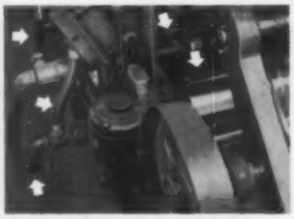

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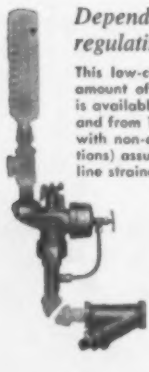

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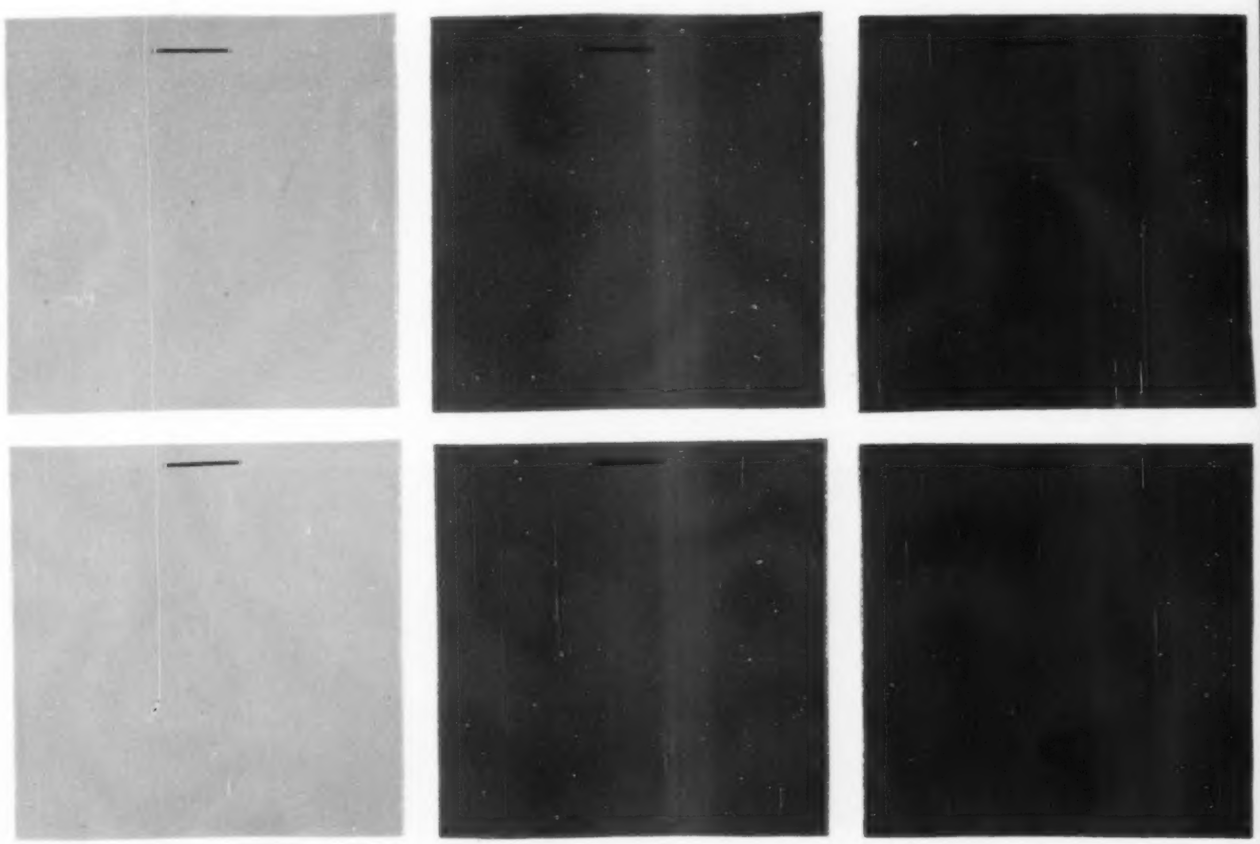

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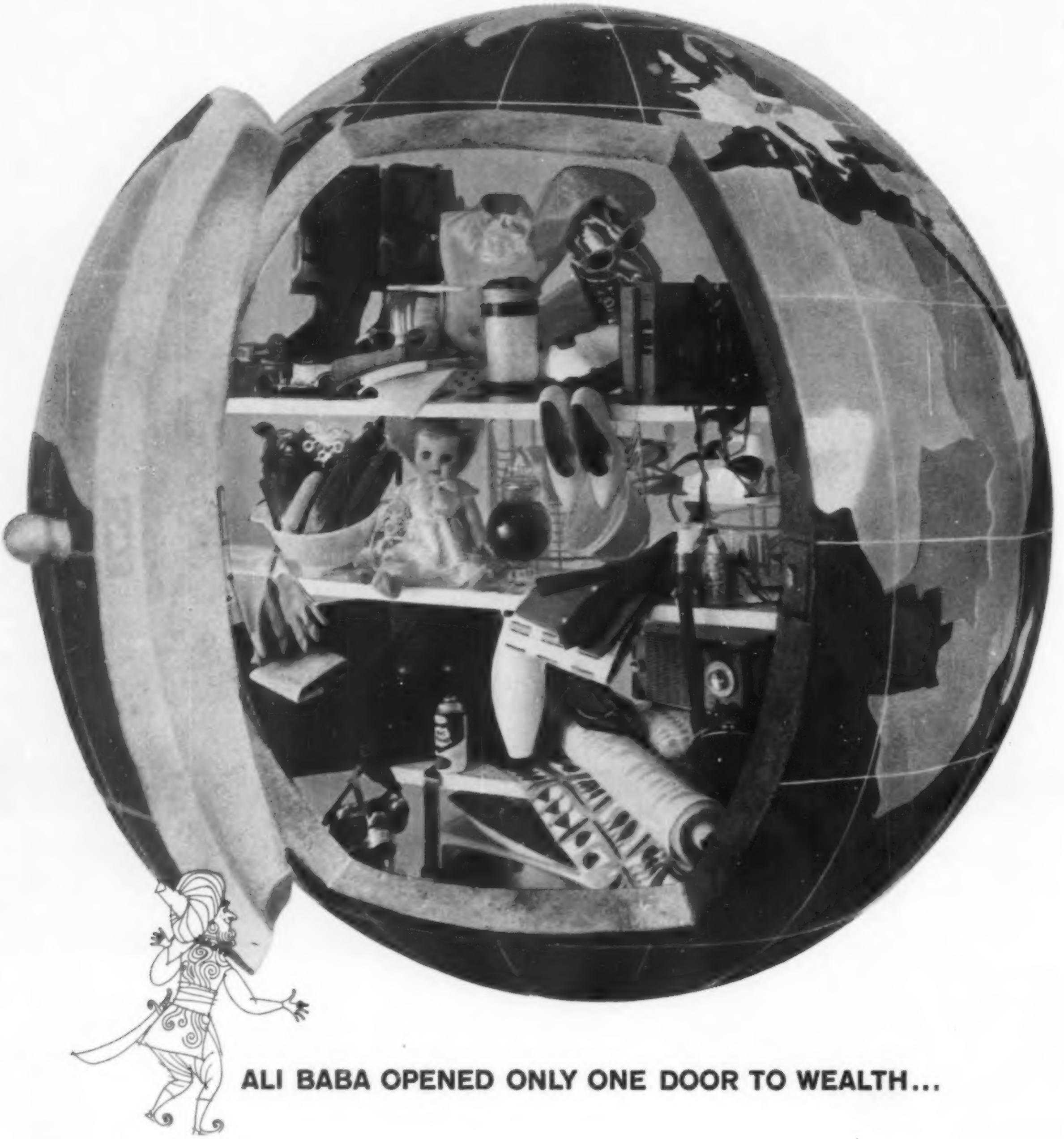

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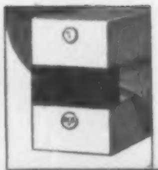

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A single piece of tramp metal "in hand" is worth thousands of dollars in production time! Any of these small pieces could cause a major plant shutdown if they scored the polished surfaces of the calender rolls. That's why more and more plastics manufacturers and reprocessors are adopting the RCA Electronic Metal Detector as standard equipment on conveyors for exploring raw materials and "pigs."

The RCA Metal Detector may be used on material traveling at speeds from 15 to 1000 feet per minute. It can be arranged to sound an alarm and/or stop the traveling material, detecting the presence of tramp metal, whether magnetic or non-magnetic, before it has a chance to do any damage to machinery.

Reduced downtime, production savings and longer life of calenders and other costly machinery all add up to a profitable smooth-running plant. We believe you will agree that RCA Metal Detectors also can be "worth thousands" in production time, once they start protecting your plant from tramp metal.

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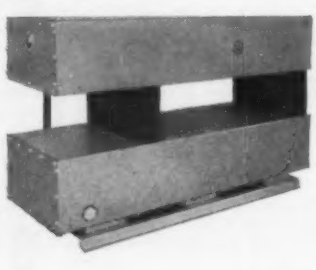
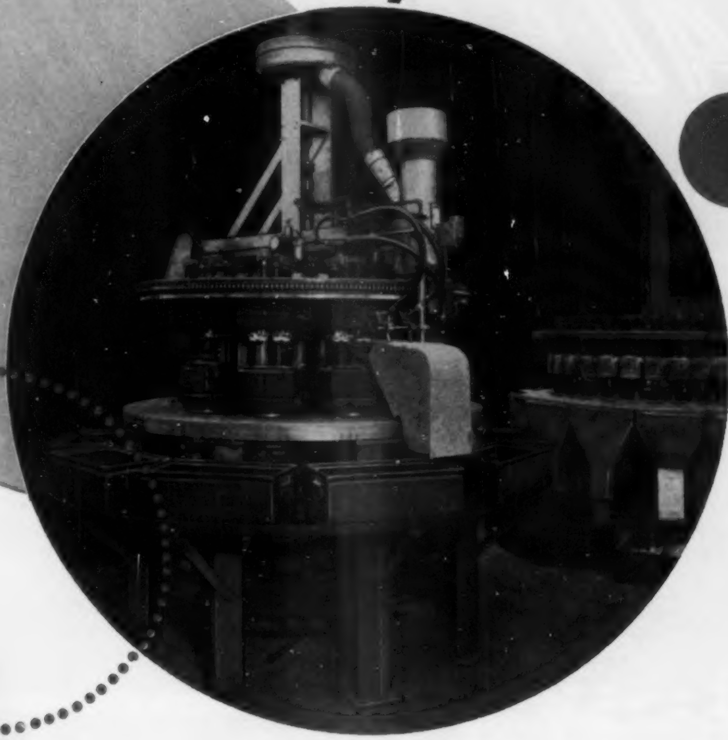


RCA ELECTRONIC METAL DETECTOR



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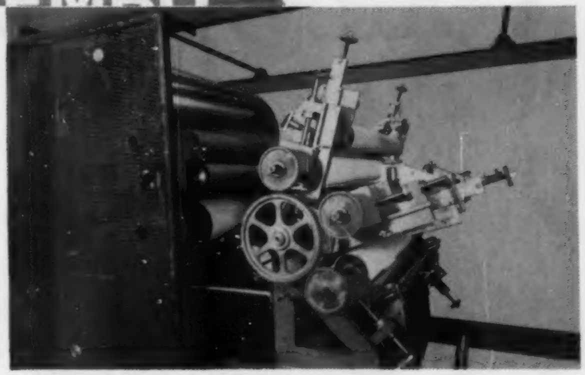

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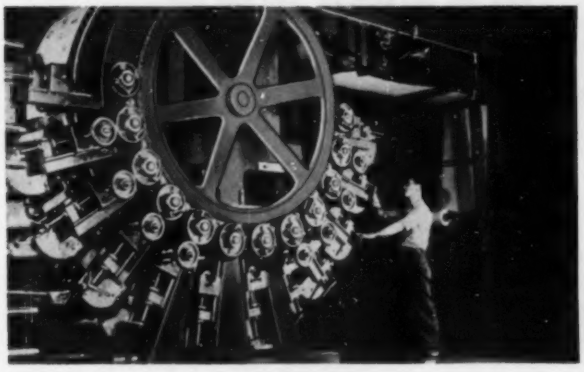

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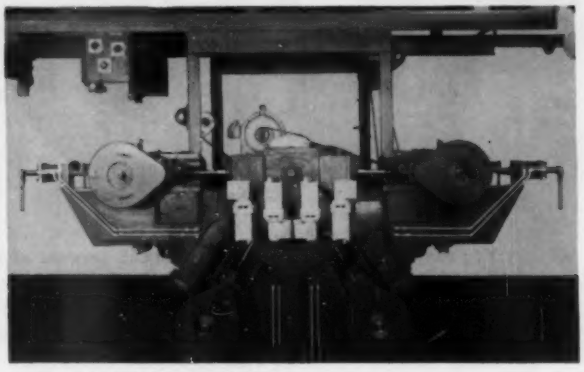

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Grueling use-test pits monomeric vs. polymeric plasticizers

Some years ago a vinyl upholstery manufacturer decided to field-test new materials for truck and transportation upholstery using a wide variety of monomeric and polymeric plasticizers, including Plastolein 9720. To compare *permanence* and *durability*, the different materials were installed on city bus drivers' seats.
Here, seat upholstering would certainly be exposed to extraordinary abuse almost around the clock . . . continuous rubbing and flexing, city grime and grit, oil and grease.

After a certain period of time, all the upholstery containing monomeric plasticizers had failed. But all those made with polymerics, including Plastolein 9720, were still in excellent shape. With this evidence, the manufacturer concluded that only a polymeric plasticizer would meet its standards for truck and transportation upholstering, and protect its reputation. And Plastolein 9720 was chosen on the basis that it was the *lowest cost of all the fine polymerics tested.*

Today, Plastolein 9720 is *still* the lowest cost ploymeric plasticizer, and is *still* being used by this and many other manufacturers in such heavy-duty goods.
Why not check 9720 yourself? Write Dept. F-10 for literature and sample.

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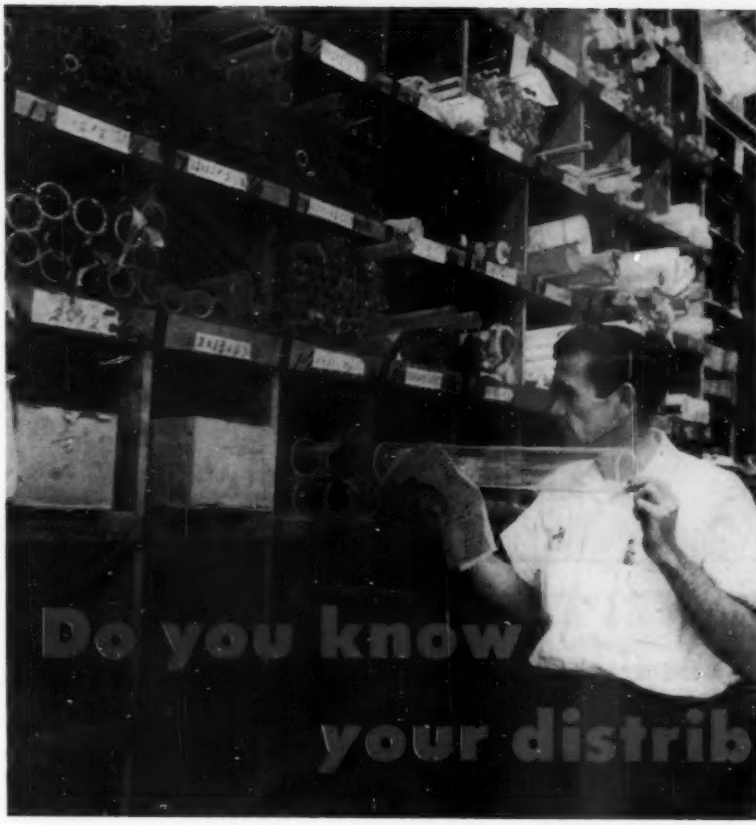
October 1959, Volume 37, Number 2

MODERN PLASTICS



Do you know your distributors?

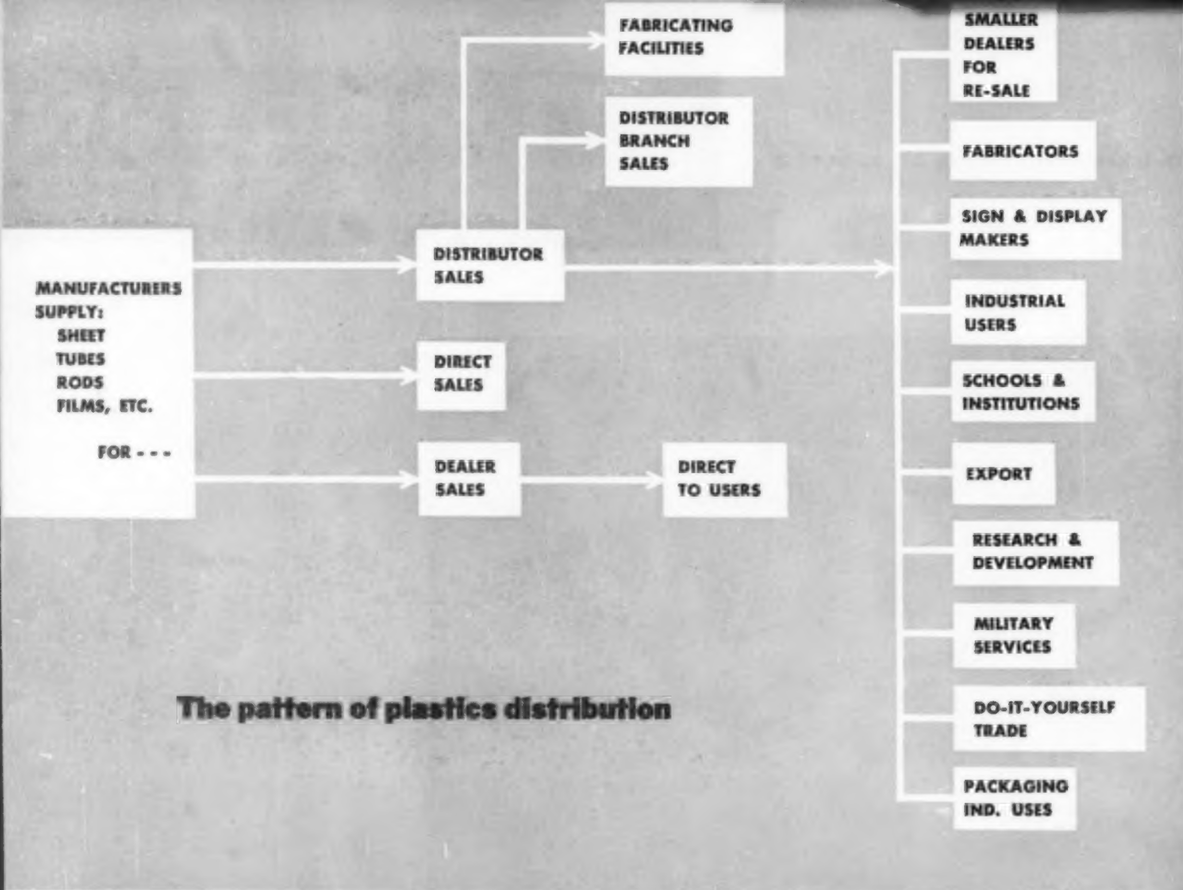
For the first time anywhere, a report on what they do, how they operate, and what benefits can be derived by those who buy and sell plastics through them

A square foot of acrylic sheeting—or a truckload of 100- by 120-in. sheets; a 6-oz. bottle of styrene cement—or a massive block of butyrate or nylon for prototype work . . . such orders are all in the day's work for companies engaged in the fast-growing business of plastics distribution, now rated by some spokesmen as a $50 million per year industry. Over 110 firms, with warehouses in some 50 cities, are presently engaged in that business.

Although there is considerable variation as to the types of materials handled, the amount of custom service offered, and the exact pattern of sales, advertising, and promotion followed, distributors are all playing an increasingly vital role in building new markets for plastics and making the average businessman more "plastics conscious."

Why deal through distributors?

There are several potent reasons why manufacturers of basic semi-fabricated plastics, such as rods, sheets, tubes, film, and sheeting, sell through plastics distributors. Similarly, there



The pattern of plastics distribution

are just as many reasons why end users buy through them:

• The good distributor has a local working organization ready and able to sell the manufacturer's products. Only at prohibitive cost could the manufacturer himself build a similar sales force.

• In addition to an accurate knowledge of the plastic materials and their working capabilities, the distributor is closely familiar with the purchasing agent's requirements, and frequently knows the buyer himself on a "first name" basis.

• Because of his specialized knowledge, he can ferret out new prospects and customers for the manufacturer's products and materials. Many cases are on record where a distributor's salesman introduced companies to the use of plastics. Some of these cases are given in detail starting on p. 85.

• The distributor serves as an inventory control medium and warehousing facility for both the manufacturers and the buyer-users.

• He generally has branches and warehouses conveniently located for effective sales penetration in the regions serviced by him. Also, he carries stocks adequate to meet most requirements "off the shelf," and frequently on an emergency request basis.

• Because he knows his customers so well, he is able to act as "credit checker" on prospective accounts which manufacturers are interested in soliciting. Moreover, accounts that manufacturers could not profitably carry on their books can be and often are carried on those of local plastics distributors, sometimes for long periods without penalty.

• In many instances, he is able to perform as a semi-fabricator on the plastic materials purchased, cutting to size, rounding and bevelling, drilling, etc. Frequently, this enables the buyer to use the material "as is," with only a minor charge to pay for these extra services.

• Although typical distributors will sell materials in very small quantities, they are usually set up to handle large orders as well. In some instances, they may also redistribute plastics products through smaller distributors and plastics retailers. Among their most dedicated customers are hobbyists and do-it-yourselfers who require plastics in handy form for personal projects. Distributors also provide an important

source of plastics to newer industries where initial orders are insufficient to go directly to the manufacturer. In fact, it has been claimed that more plastics reach the research and development departments of such firms today through distributors than through any other source of supply. A chart outlining the flow of plastics products through distributors' channels appears on the opposite page.

An important incidental service performed by the plastics distributor is his function as a quality control medium. Reputable distributors, as a matter of self-interest, tend to hold off the market any materials which fail to meet established standards. They know that any complaints about poor quality will inevitably come to them as the original supplier of the product involved. One major distributor suggests that easily visible markings on each sheet of material, placed there by the original producer, would go a long way toward eliminating any possibility of substitution—a practice scrupulously avoided by reputable distributors.

Who buys what?

Reporting on its own operations, one major plastics distributor with warehouses in 11 cities states that the largest single category, by a wide margin, is for industrial maintenance and general plant use, covering a broad cross section of industry. Some typical applications are:

Cast acrylic sheets: Glazing, light fixtures, safety guards, development models, housings, signs, plating fixtures, inspection windows, etc.

Nylon rods and sheets: Bearings, gears, seals, wear strips, washers, and conveyor channels.

Polyethylene: Film for vapor barriers and protective covers; sheets or rods for HF insulators, gaskets, pumps, tank liners, etc.

Vinyl: Rigid sheet stock for displays, templates, charts, dials, etc.; flexible film for protective covers and gaskets; flexible tube for chemical, food and coolant lines, laboratory tubing, and gaskets.

Teflon: For insulators, bearings, valve seats, non-stick roll coverings, and work surfaces.

Styrene: Insulators, breaker strips and cold service parts.

Polyester with fibrous glass: For tooling and prototypes, etc.

Other important user categories, according to this distributor, include "small fabricators," which account for about 10 to 15% of total sales; sign and display builders, who use large quantities of acrylic, vinyl, acetate, and high impact styrene sheets, as well as acrylic rods

The next 10 years in distribution

By Richard J. Jacob*

We believe the major trends of the next 10 years in plastics distribution will be:

1. Present plastic distributors who now concentrate on sheets, rods, tubes, and films, will also become warehousers and sales agents for resins and molding powders. On the local scene, the resin suppliers will limit their staffs to technical people. The distributor will handle the direct sales and routine services, even on very large accounts.

This shift will come about because of the suppliers' rising cost of field sales and branch offices. The distributor, already in the area, is geared to direct sales and rapid deliveries and to making a profit on even small units of sale.

2. Non-ferrous and specialty steels warehousers will expand into the distribution of plastic sheets, rods, and tubes—particularly in the plastics which compete with or supplant metal shapes.

3. Plastic materials suppliers will develop a multiple distribution pattern to reach the building and agricultural markets. The supplier of a special laminate for building use, for example, will probably distribute simultaneously through regular plastics channels, through building products distributors and through metals warehousers.

4. Distributors will expand their educational services to users and will add technical services. The number of plastic families has grown so rapidly, to say nothing of special formulations and copolymers, that even sophisticated users now require guidance.

5. There will be a considerable increase in the numbers of small plastic dealers, dealer-fabricators, and mill supply houses stocking plastics as sidelines. This is a reflection of the growing national interest in plastics as materials of industry.

However, the decade will pose a severe challenge to the basic warehousing distributors. To keep up with their new functions and new competition plus the sheer growth of the plastics market, they will need ample financial resources, large investments in warehouse facilities, handling equipment, and well-trained, technically competent staffs.—End

*Executive Vice President, Cadillac Plastic & Chemical Co., Detroit, Mich.

TYPICAL DISTRIBUTOR'S sheet storage area is exemplified by this view of Commercial Plastics & Supply Corp. warehouse. Typical tube storage set-up, as designed at Cadillac Plastic & Chemical Co., is depicted on p. 81.

and tubes; and lighting firms, which purchase vinyl and acrylic sheets. Machine tool firms utilize a general assortment of materials for industrial maintenance. They also purchase cast acrylic rods and tubes for oil cups, visible filters, and related uses.

Electronics manufacturers are good customers for styrene, polyethylene, nylon and Teflon (for insulators, bearings, etc.). Manufacturers in the marine field favor acrylics and reinforced plastics. Costume jewelry producers and eyeglass frame manufacturers work most frequently with vinyl and regular and pearlescent acrylic stocks.

Agricultural and housing applications account for increasing volumes of polyethylene and vinyl film, acrylic sheet and reinforced plastic sheet stock. These materials go into such end uses as pond and ditch linings, silage and greenhouse covers, moisture barriers, glazing, canopies, and ornamental applications.

Government agencies are important purchasers of plastics shapes, which are usually for unspecified uses.

There is also a large over-the-counter trade with "plain Joe's," who may buy a supply of

Distributor educates public

Cadillac Plastic and Chemical Co., the nation's largest plastics distributor, has developed an outstanding educational program which supplements its regular sales activities. This includes not only informative printed material, specially prepared to assist customers and prospects in working with plastics, but also lectures to professional chapters of purchasing and engineering groups.

More than 150 such talks have been given to date. Attendance at these presentations has ranged from 8 to 250 persons, averaging about 40. In addition to professional groups, talks are made before various service clubs, company engineering, and purchasing departments, and some college engineering or industrial classes. Six basic types of presentations are used, each having its own specialized type of display materials, such as plastic samples, films, slides, charts, etc. All talks are made on a strictly educational level without mention of the company name. Plastics covered are referred to by their generic names, rather than by their tradenames.

Speakers are instructed to keep talks brief, permitting ample time for questions and detailed examination of display materials. Some question periods have lasted as long as an hour and a half, reflecting the crying need for plastics education at the end user level.

Informative literature is made available to those attending. This literature provides a quick and authentic over-all picture of the industry and its products, pointing out that plastics "are not just one animal" but a whole category of materials, differing from one another as much as Babbitt metal from carbon steel. Properties and typical applications are listed for nylon, Teflon, polyester film, phenolic laminates, acrylic and modified acrylic, polyethylene, vinyl, polystyrene, cellulose acetate and butyrate, fibrous glass reinforcements, and polyester and epoxy resins.—End

Plastics distribution abroad

By Herman Arthur*

During my recent five-week tour through Europe and Israel, I was able to call upon several leading distributors of plastics abroad who provide materials similar to our own—that is, in sheet, rod, tube, and film form. The materials, I emphasize, were similar; the distribution methods, however, were worlds apart. Nowhere on my trip did I see a distribution network in operation such as we enjoy in this country. Nor did I see anywhere, at any one place, the variety of stocks nor the stocking in depth that is typical of even the modest-sized dealer's plant here in the United States.

France: One is immediately struck by the lack of visible use of plastics in such accepted forms as signs and displays. Household items, yes—clothes baskets and pails, funnels and curtains, and other finished products—but plastics in their "first forms" are not available generally, apparently, are not used on so broad a scale as here, and certainly are not distributed in the same manner as in the U. S. Here and there in France one might find a specialist in a particular plastic, but again, usually in selected forms and shapes. Generally, too, he worked from a price sheet. He had no complete catalog of items and materials similar to those published here and made available on request.

Italy: There seems to be much more diversity of the plastics materials available and manufactured, including acrylics, vinyls, polyethylenes, acetates, and the like. In Northern Italy, particularly in the Milan area, there were many distributors of molding powders, but only a few distributors of laminated phenolics, polyethylene film, and vinyl sheeting. And, of course, little nylon or Teflon in sheet, rod, or tube form are obtainable there, except what is imported—and only one distributor in Rome seemed to have a variety of different kinds of sheets, rods, tubes, and film, which he sold in conjunction with parts for machinery.

Switzerland: Almost no plastics materials distribution in the same sense as we have it here in the States. Like the Germans, the Swiss would rather sell than buy. They have specialized in injection and compression molding machinery, extrusion equipment, and molded parts for domestic consumption and for export.

Greece: Hard-hit economically, nevertheless, Greece had two or three small distributors who handled acrylics and other specialties. But again, no general line stocks in depth were carried.

Israel: No evidence of plastics distribution at all. But most industries there are growing by leaps and bounds, and undoubtedly when the need is there for them, plastics in stock forms will appear. As of the moment, only household items have some plastics in them.

To sum up, whatever plastics materials distribution exists in the countries I visited seems to be on a specialized basis right now. Naturally, therefore, firms abroad cannot buy plastics materials with the same readiness and ease as do industrial and commercial firms here in the States—where a phone call to one of several local distributors will probably have it at the back door tomorrow. As plastics uses increase over there, we can expect these specialists to be encouraged to diversify into the "general lines" type of operation we enjoy in this country.—End

*President, Commercial Plastics & Supply Corp., New York, N. Y.

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polyethylene film to moisture-proof a crawl space or fibrous glass and polyester resin kits for covering a wooden boat hull.

School shops also come to plastics distributors for acrylic and acrylic scrap, reinforced plastics, and polyester or epoxy kits used in casting and embedment work.

Cases in point

The following case histories, taken from a leading plastics distributor, illustrate the types of problems encountered by distributor sales representatives, and how they were solved by specifying proper types of plastics materials:

Housing for machine tools: The housings for various machine tools in one plant visited by a plastics distributor representative had to be removed periodically during maintenance periods. Made of cast iron, they weighed from 80 to 100 lb. and cost an average of $12.80 for disassembly. Recalling how another firm had employed reinforced plastics to meet a similar problem, the salesman suggested that the customer switch to reinforced plastic housings. The company was able to fabricate the new plastics covers, weighing only 10 lb., at a cost of $8 to $9 each. With the new housings, highly skilled operators were no longer needed to remove and replace the covers.

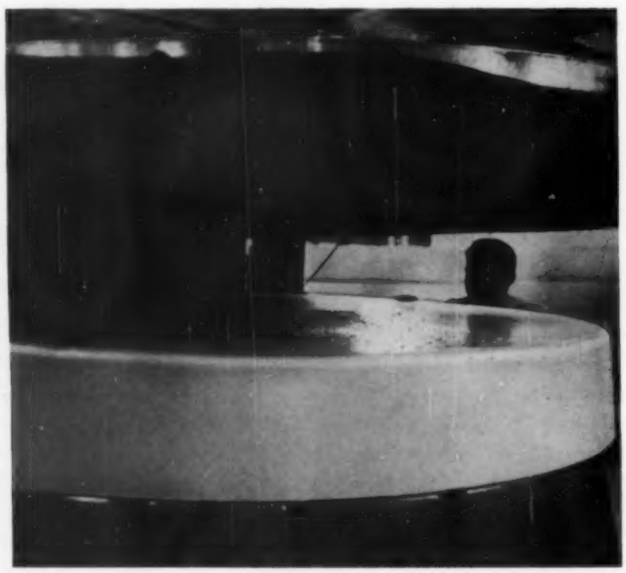
Conveyor chain dilemma: A bottling firm used a chain conveyor to transport bottles through the plant, lubricating the chain with soapy water to reduce friction. Periodically, the equipment was shut down while worn surfaces in the conveyor channels were built up by welding. A distributor salesman, watching this operation, suggested installation of nylon strips beneath the moving con- **(To page 194)**

PORTABLE

ALL-PLASTICS SWIMMING RAFT, 80 in. in diameter and weighing less than 100 lb., eliminates periodic painting and other maintenance headaches experienced with conventional wooden or metal floats. Colorful rope rail is made of polyethylene monofilament.

MOLD in which pre-expanded styrene beads are molded into one-piece raft core weighing 22 lb., shown in open position; 1000-ton-capacity press, at left in photo, has 8-ft.-sq. platen area. Mold moves out on track for loading and unloading.

CORE at end of molding cycle, after ejector pins have lifted it from the honeycomb lower section. Four cores are produced per hour.



ISLAND

Swimming raft, fabricated of molded expandable styrene foam core and RP shells, weighs only 90 lb. but can support 4/5 ton

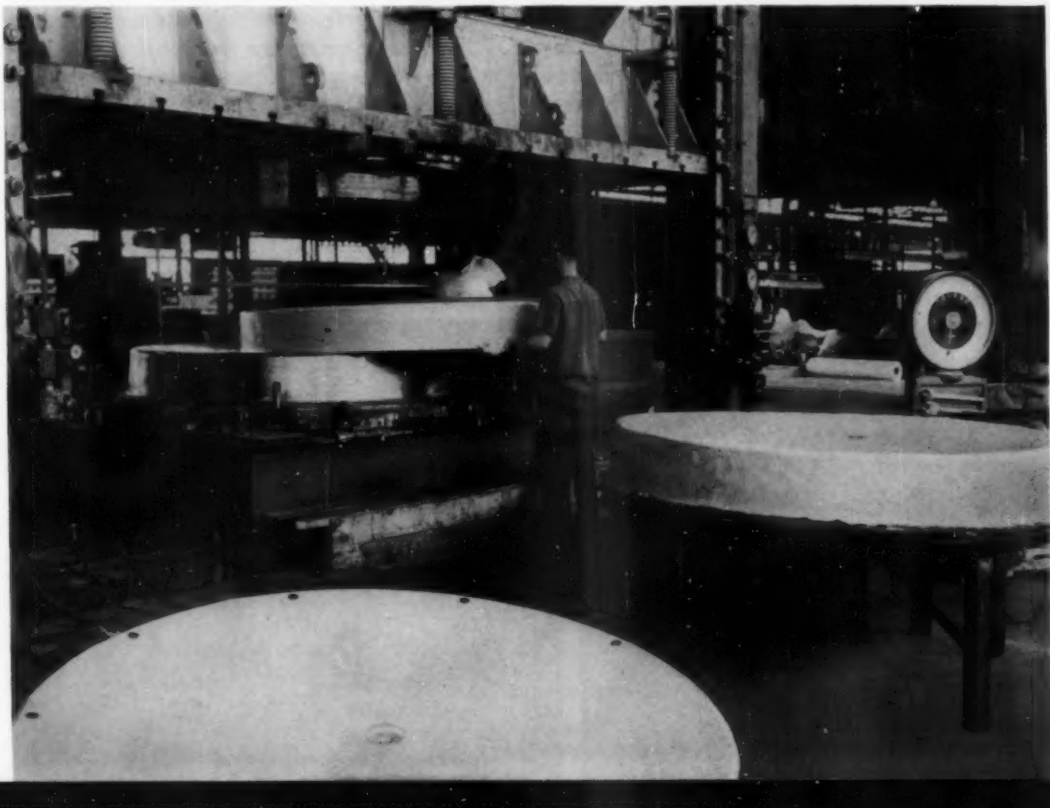
A new concept in swimming rafts—an 80-in. diameter all-plastic unit consisting of a molded expandable styrene foam core enclosed in a reinforced plastic outer shell—is now in production by Fiber-Foam Marine Products, Inc., Oconomowoc, Wis.

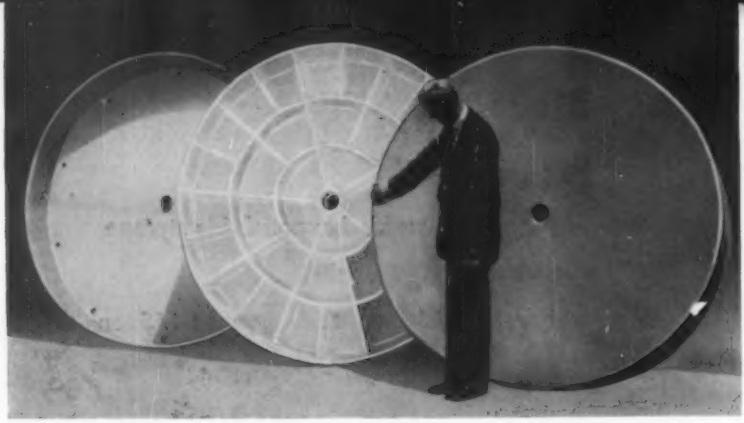
Designated Play-buoy, its advantages over the familiar resort raft, made of steel drums supporting a wooden platform, are many: With a weight of about 90 lb., the plastic raft may be easily detached from its anchor chain, removed from the water, and rolled like a giant wheel to a car or trailer for convenient transport to a new location. The RP shell, impervious to sun, water, and marine parasites, will not rot, splinter, or leave dangerous jagged edges. Its molded-in color not only eliminates periodic painting but also does away with other maintenance problems as well.

Unlike a metal raft, which would have been very heavy as well as costly to fabricate, the Play-buoy cannot rust or corrode, even in salt water. Despite prolonged exposure to sunlight, its top deck does not become uncomfortably hot, whereas a metal raft under similar conditions would become almost unbearable. The smoothly rounded contours of the Play-buoy raft, easily achieved with plastic molding techniques, eliminates sharp corners and edges which might cause injuries or damage boats. List price is about $230.

Virtually unsinkable, the Play-buoy raft will sustain from 8 to 10 adults (1600 pounds). About half of its 20-in. thickness appears above

OVER-ALL VIEW OF RP MOLDING AREA, where top and bottom shells of raft are produced. Operators are removing finished piece from 1000-ton press with 12-ft. daylight and a platen area of 6 by 16 feet. In right center is preform which will be molded next. In left foreground is a finished bottom section. Small holes along periphery admit water which serves as ballast. The large hole in the center accommodates an aluminum tube assembly that holds raft together and permits attachment of anchor tube and chain. The raft will sustain the weight of eight to ten adults.





THREE main components of basic raft. Center piece is molded expandable polystyrene core. Honeycomb construction ke..s weight down while maintaini. strength. Weight of the two reinforced plastics shells is 33 lb. each.

water when afloat. The one-piece polystyrene foam core, molded with multiple "pockets" in the bottom, is mounted in the upper half of the shell, leaving the lower section empty. Openings cut in the bottom half, near the outer edge, allow water to enter the lower section. This provides 1200 lb. of water ballast, giving the raft remarkable stability. If the Play-buoy is to be removed from the water for any reason, tipping it on edge in shallow water quickly drains the ballast.

Other features of the new raft include a choice of five top colors (all bottom sections are light gray); an aluminum tube assembly, which holds the top and bottom together at the center, permits drainage as well as provides attachment for an anchor tube and chain; and an optional rope rail, which is made of colorful polyethylene monofilament. Additional accessories complete the raft's components.

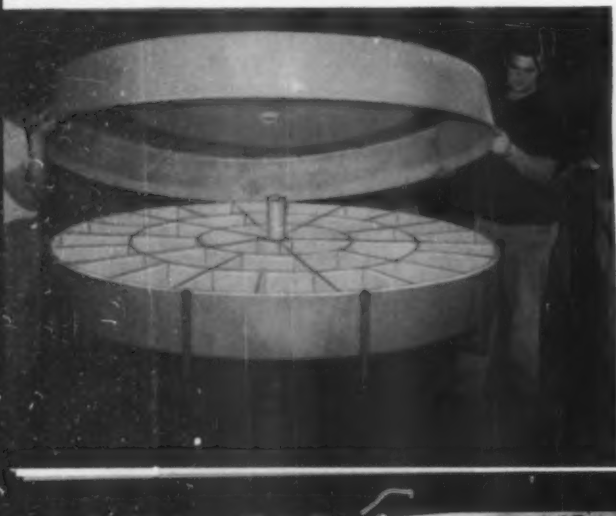
How they are made

Both the styrene foam core and the RP shell of the Play-buoy raft are believed by the manufacturer to be among the largest press-molded parts ever made of these materials. The core, weighing 22 lb. and having a density of approximately 2 lb. per cu. ft., is molded of Dow Pelaspan by Glo-Brite Foam Plastic Products, Inc., Chicago, Ill. The pre-expanded beads are molded by the steam injection technique in a large cast aluminum mold mounted in a specially built press weighing 40 tons. The RP shells of the raft, weighing approximately 33 lb. each, are produced by the Plastics Div. of General American Transportation Corp., Chicago. The single-cavity matched metal mold is mounted in a 1000-ton compression press to produce these parts.

The two halves of the glass-reinforced polyester shell are identical, having a flanged edge which is stapled and bonded with epoxy in the assembly operation. These sections are molded with a roughened, non-skid and non-glare top for greater safety. Slightly concave, the deck surface prevents slipping off the edge and allows water to drain through the metal tube in the center.

Accompanying photos illustrate production of the core and exterior shell of the Play-buoy raft, as well as some of the basic final assembly operations.—End

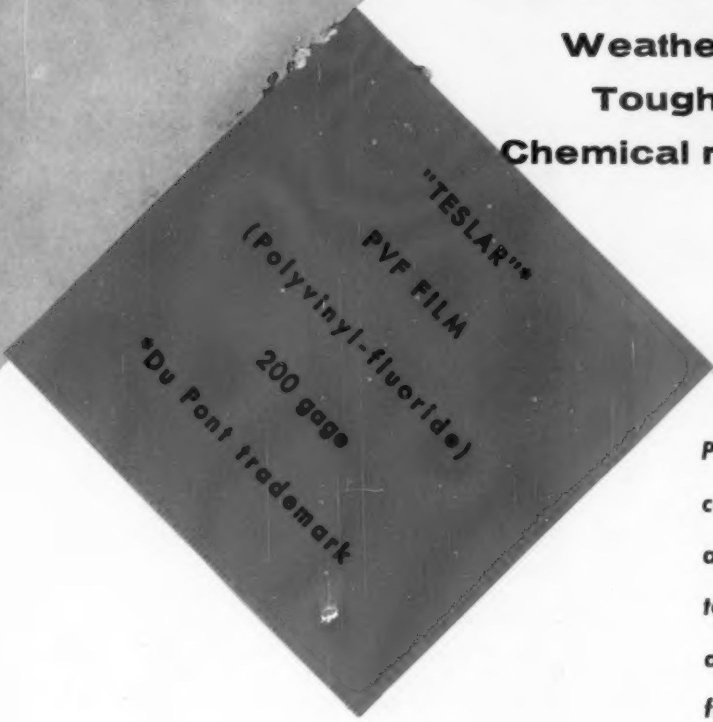
ASSEMBLING THE RAFT. Core has been spot cemented with epoxy resin to inverted top RP shell and bottom shell is being lowered into position. Both shells have flanged edges, which are also bonded together with epoxy resin and will later be stapled.



OPERATORS APPLY extruded vinyl gasket which covers seam of raft. Later operations include attachment of PE rope rail, anchor clasp, anchor tube cap, and identifying decal. Rivnut blind rivets are used in mounting fittings to reinforced plastics shell.

NOW— in one film:

Weatherability
Toughness
Chemical resistance



Polyvinyl fluoride film can be used outdoors for glazing and as a laminate to protect wood, aluminum and other materials from deterioration for many years

Considerable excitement has been generated with the semi-works introduction of polyvinyl fluoride (PVF) film. Here is a material that combines flexibility with inherent weatherability, toughness, and chemical resistance . . . and, when in full production, is expected to sell in the range of polyester film prices.

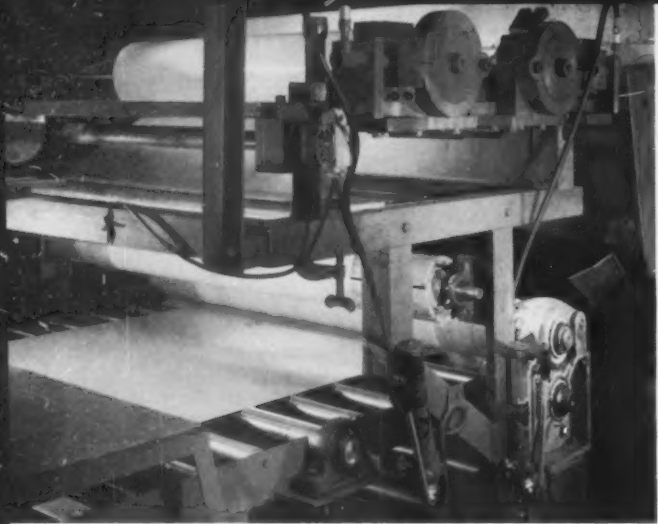
Vinyl fluoride has been in the laboratory for many years. During World War II it was talked about in research departments as a plastic with properties of almost unbelievable excellence. Theoretically, it could be used outdoors with a life expectancy comparable to that of many of the better building materials. But occasional checks with a number of interested companies invariably led to the same answer from all: "The stuff can't be handled—we just can't make it—it's a Jonah."

But now Du Pont has mastered the complex technology involved in polymerizing the material and forming it into a usable product. Film made from this material is presently available from a semi-works plant under the designation Teslar PVF film. In development form it was called "R" film. The projected price on a commercial-production basis will be about the same as Du Pont's Mylar polyester film, but its uses will be confined, temporarily at least, to those fields where it will do a better job than other materials and thus pay its way, according to Du Pont.

Where it excels

Teslar's most outstanding properties are weatherability, toughness, and chemical inertness. Thus it is expected to find use in protecting other material from the elements, i.e., become a paint substitute. When a plastic film can replace paint as a prefinishing medium for outdoor use, its potential volume is immeasurable. This material has now reportedly been used on a variety of structures in Richmond, Va., and Buffalo, N. Y., over plywood and hardboard with no sign of surface deterioration after three years' application.

Tests cited by Du Pont indicate that a 2-mil white pigmented Teslar film bonded to aluminum or galvanized sheet will last 15 to 30 years;



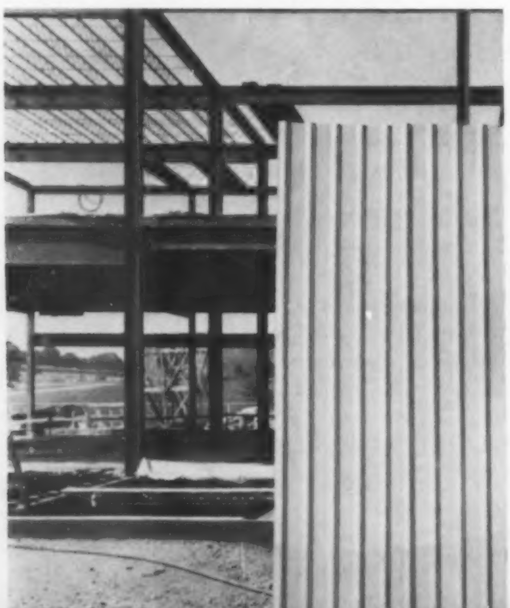
POLYVINYL FLUORIDE film is laminated to galvanized sheet in operation normally used for bonding PVC to metal by the Marvibond process. Film is on the upper roll; nip roll is in the center; and sheet on rollers has been laminated.

FORMABILITY of PVF film laminated to heavy-gage polyvinyl chloride is demonstrated by display rack produced on conventional vacuum forming equipment. White pigmented film was used in this particular demonstration.

if it shows signs of degradation, it can be resurfaced with paint. In comparison with other surfacing material, its resistance to damage is claimed to be very high. As a result, it may be readily handled in prefabricating operations without any harm.

A major market is expected to be metal prefinishing—as a laminate for aluminum, galvanized steel, and aluminized steel. While it has not yet been evaluated for skyscrapers or industrial buildings, it is said to be particularly applicable to prefinished house siding (replacement as well as original); prefabricated commercial buildings, such as warehouses and bowling alleys; and as a skin material for foamed-in-place building panels.

METAL BUILDING PANEL has gray-pigmented PVF film laminated to its outside surface. Film was applied before corrugation. In this application, it is both decorative and functional.

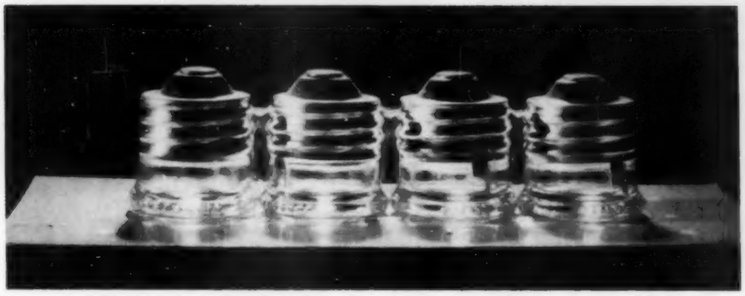


For better roofs and glazing

As a prefinish for roofing material, 3-mil Teslar laminated to a 15-mil polyethylene film or to roofing felt offers something radically new. Such a flexible roofing material can be applied to rigid substrate panels at below 15¢/sq. ft., which is comparable to asphalt at 10 to 12¢, according to Du Pont technicians. The advantages over asphalt are said to be: reduction of heat load, reduced application cost, improved weatherability, and freedom from maintenance. It appears that the flexible material can be laid down on a roof deck at a cost comparable to built up roofs, and Du Pont is studying various systems.

It is also usable as a glazing material. The possibilities for its application in chicken houses, piggeries, transparent tarpaulins, storm windows, and air-supported structures are most encouraging, especially because of its fabricability and heat-sealability by hot-bar electronic and impulse methods. Several greenhouses, with Teslar supplanting glass, are already in existence.

A number of plastics manufacturers are evaluating the film as a release sheet and for bag-molding. The price-per-pound advantage of PVA and some other films currently used may be offset by the use of thinner gages of Teslar, which is claimed to have superior release properties, surface inertness, and thermal stability. The new film is also reported to have been suc-



CONVENTIONAL skin-packaging techniques were used to produce this package of fuses. Note close conformity of film to product. Two-mil gage was used in this application.

cessfully used in application where only higher-priced Teflon had previously been found effective, e.g., in epoxy molding.

Broadens vinyl-metal markets

Teslar also suggests new market opportunities for producers in the vinyl-to-metal field since the film will expand the range of properties they can offer. The same is true of the strip-coating field where baked enamel is used.

There are now eight or more processors of vinyl sheet for metal bonding who sold an estimated 40 million sq. ft. last year; and Teslar not only is expected to invade the field in some measure, but extend this application to more widespread outdoor use. Du Pont spokesmen also think it can be handled like vinyl plastisol spread-coated on steel by substituting a roll of film for a tank of plastisol. Two mils of film would assertedly do the job of 10 mils of plastisol, and thus give Teslar a competitive price position. But here again there are differences—plastisol coatings, unlike Teslar, are not suited for outdoor applications; on the other hand, unlike plastisols, 2 mils of Teslar cannot be embossed for decorative effects. But 1 mil of pigmented Teslar laminated to 10 mils of PVC produces a material that is both weatherable and ideal for embossing.

Teslar is expected to find use as a surfacing material for other plastics to improve their weatherability, strain resistance and toughness. A ½-mil film laminated to upholstery is good for heavy duty use on planes and trucks. Also, it is produced in a delustered form.

A new type of Teslar just developed is characterized by properties particularly useful for thermoforming. Here it combines its other properties with 300 to 400% elongation. It will most likely be used in combination with other materials—PVC in particular. At the present time, a technique for bonding to styrene-type sheets has not been found.

The film will bond adequately to ceiling and acoustic tiles as a protective or decorative coating. Compared to methacrylate, which can't be heat sealed, and to polystyrene which is not particularly weatherable, Teslar offers interesting possibilities for ceiling applications. As a factory-applied covering for foamed pipe insulation, Teslar looks promising as an economic replacement for field applied cut-back mastic.

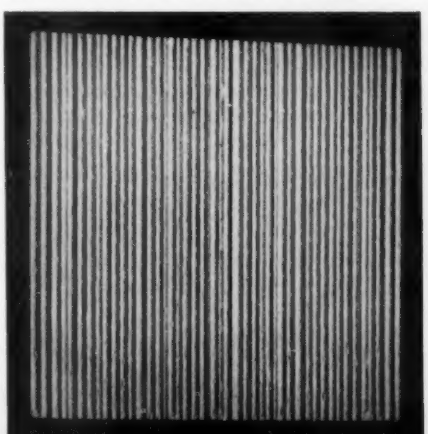
Another interesting application for outdoor use is two sheets of clear Teslar laminated together with printed fibers of Teslar inserted between to give a highly decorative appearance.

Packaging applications

There are also possibilities for vinyl fluoride film as a packaging material where its heat sealability by the same methods used for polyethylene, grease resistance, low oxygen permeability, and toughness offer desirable properties. It is possible that it may be used where lower cost films are impractical for such uses as packaging bearings, chemicals, greasy substances and hair dyes.

Electrical markets are high on the list of potential uses, too. Because of its high dielectric constant, it could be used instead of paper, oil, or even Mylar in capacitors. Because of its resistance to thermal degradation and the effects of hydrolysis, it can be expected to lengthen the life of electrical apparatus when exposed to constant heat. It is claimed to **(To page 200)**

ACOUSTICAL TILE surfaced with Teslar film, which conforms closely to rough corrugated surface. Film not only improves appearance of tile, but also makes it much easier to clean.



High-density PE breaks into the luggage market with

FIRST all-polyethylene flight bag consists of two identical halves joined by ingenious hinge arrangement (see photo at left). Each half weighs 3/4 lb.; three gates (see marks on inside of bag half) are used in molding.

A far cry from the zippered nylon fabric flight bag now used by thousands of children to carry school books and gym togs is the new Pan American World Airways flight bag, designed by Donald Davidson and Charles Forberg of Edward L. Barnes Associates, New York, N. Y., working in conjunction with Plastics Engineering Sales Co., Jackson Heights, N. Y., and now in mass production at Penn-Plastics Corp., Glenside, Pa.

The new unit looks like and is, in fact, a quality piece of luggage, though unlined. It is light in weight, properly shaped for space saving in shipping and storing, and has unlimited re-use value.

Four basic requirements, in addition to the above mentioned qualities, were demanded by the purchaser. First, the cost had to be reasonably competitive with sewn fabric bags, because the product is given away to all first-class passengers. Second, it had to have ample display area for the famous Pan American trademark. Third, it had to be injection molded for mass production; and fourth, it had to be assembled with a minimum of labor—a factor which is related to cost.

The design concepts were based on these requirements and came up with the idea of two identical molded shells which snap together along an integrally molded hinge. The two shells nest together for storage and shipping, allowing 12 complete cases, nested, to be stored in the same space volume as three assembled cases. Thus, mold costs were kept relatively low because one cavity produces both parts, including the mating of two halves of the handle, which is integral with the case.

Marlex high-density polyethylene was the material selected for this application, and Standard Tool Co., Leominster, Mass., made

the mold. It was not as simple a job as the crisp appearance of the bag would imply. With the handles, hinge, joint laps all integral; with smooth, slick molded surfaces required for lap trim and handle; and with such a wide area to be filled and set on a 35-sec. cycle, many problems had to be overcome. A Lombard Governor 16/20-oz. press was selected and single, double, and triple gating were experimented with to achieve the proper flow. Finally, three gates were used feeding into the inner side of the shell, with the use of special water channeling in the force to dissipate the heat at a desired rate, and with a specially-designed sprue bushing for the use of a heaterless, insulated hot-runner system. After cavity filling was overcome, it was possible to speed the cycle by using refrigerated water in the force to dissipate heat and speed the cooling. Because of the design of the molding, it was necessary to use a water-chilled shrink fixture to assure maintenance of shape and fit in assembling the two halves, either in the molding plant or in any Pan American depots.

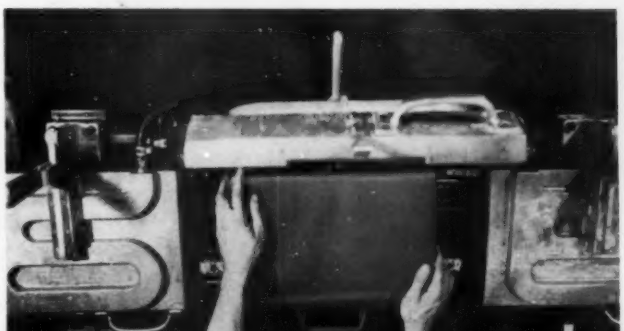
Immediately after release from the shrink fixture, the trademark in white is hot stamped on the blue bag and the small aluminum clip is peened into position on an automatic jig.

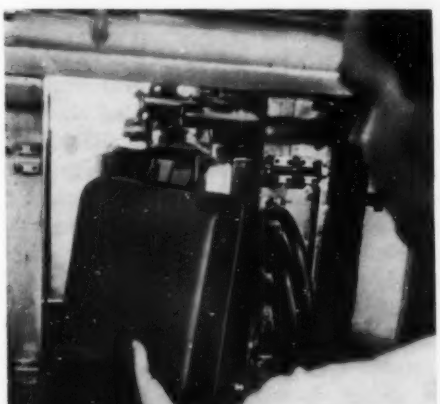
Reaction to the bag in the field has been excellent, and it is believed that this is but the first of a range of low-cost luggage developments in polyolefin materials.—End

The Pan Am flight bag

U. S. airline picks material for give-away luggage because it makes possible new concept in flight bag design at a cost reasonably competitive with sewn fabric cases

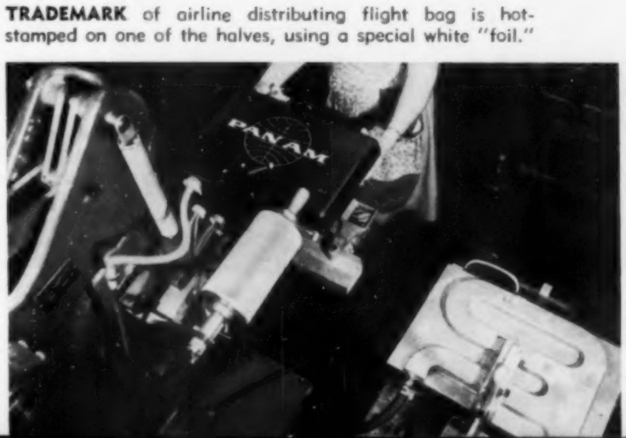
REFRIGERATED shrink fixture is used to assure that molding maintains its shape and fit and does not warp in use. →





FINISHED bag half is removed from the injection machine. Single-cavity mold is used, and the operation is on a 32-sec. cycle.

TRADEMARK of airline distributing flight bag is hot-stamped on one of the halves, using a special white "foil."



LAWN MOWER motor shroud is molded of glass reinforced polyester premix. Choice of material resulted in production economies, better design.

12% part cost reduction,

lower tooling,

quieter operation . . .

these are among the factors that prompted Lawn-Boy Div., Outboard Marine Corp., Lamar, Mo., to specify molded polyester premix motor shrouds rather than metal for its top-of-the-line Quietflite 1959 model power mowers. The decision also opened up additional styling possibilities which give the mower a distinctive, attractive appearance.

The principal economic advantage of the premix part is in the piece cost, which runs approximately 12% less than for a comparable metal shroud. Essentially, this saving is the result of reduced finishing requirements. The small amount of flash on the premix shroud is easily removed with a file by the press operator, whereas with a die-case aluminum shroud, flash removal would have to be handled on a "snag grinder"—a considerably more difficult and costly operation. Additionally, "brushing up" would be required to prepare the metal part for priming and painting. Tool cost savings added to over-all production economies.

The thermal and acoustical properties of the RP material also have advantages to ultimate purchasers. Unlike a metal cover, the plastic

PREMIX compound is extruded as a solid bar and automatically cut off to proper length by guillotine cutter. Precut charges are stacked in foreground, ready for molding machine. Operator in background checks functioning of mixing operation in spiral blade mixer (not visible).

TWO PREMIX rods are placed crosswise on top of punch of mold mounted in 150-ton compression press. Molding pressure is 300 p.s.i.

AFTER 45-sec. molding cycle, finished shroud is removed. Note thin flash on sides which will be taken off later by simple hand file.

shroud does not heat up in use. The fact that it cannot rust or corrode simplifies the maintenance problem: the mower may be hosed off without damage after use.

Because of the lighter specific gravity of polyester premix as compared to die-cast aluminum (approximately 2.0 vs. 2.7), it was possible to design the housing with a somewhat thicker wall section without incurring a weight handicap. This design feature, coupled with the basic sound insulating properties of the plastic material and rubber engine mountings, reduces engine noise to a gentle purr.

Production steps

Outboard Marine manufactures the reinforced plastics shrouds in its newly-established plastic molding facility at the Gale Products Div., Galesburg, Ill.

At that modern facility, chopped glass fibers, polyester resin, clay, and other ingredients are blended in a 180°, single spiral blade, jacketed mixer manufactured by Baker Perkins, Inc., Saginaw, Mich. The finished molding material emerges from a Bonnot extruder (The Bonnot Co., Canton, Ohio) in the form of a continuous "rope" approximately 2 in. in diameter, and is cut off automatically to proper length by a guillotine-type cutter produced by Erie Industrial Products, Inc., Cicero, Ill. Glass reinforcement is supplied by Owens-Corning Fiberglas Corp.; polyester resins are from Rohm & Haas Co.; Pittsburgh Plate Glass Co., Selectron Div.; and H. H. Robertson Co.

The press operator places two of the bars of premix on the punch of a 150-ton HPM compression press and initiates the molding cycle.

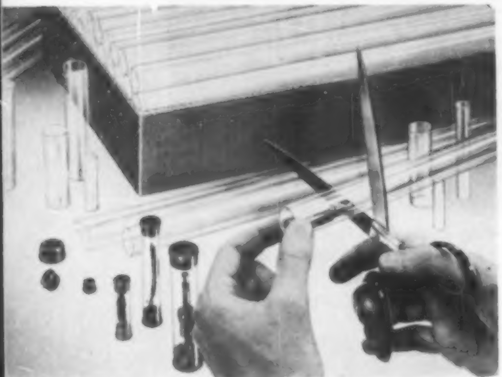
AFTER FLASH has been removed, shroud is placed in shrink fixture, where four holes are drilled in side for attachment of air intake screen. Drilled covers are stacked in bin at left for shipment to lawnmower plant in Lamar, Mo., where they are painted and mounted.

Molding is at 200 p.s.i. pressure, on an approximately 45-sec. cycle. Upon removal from the mold, the part is deflashed by the press operator and placed on a shrink fixture, remaining on the fixture while four holes are drilled for attachment of an air intake screen. Following final inspection, the shrouds are nested in large wooden containers in which they are trucked to the Lawn-Boy plant in Lamar for painting and final assembly.

The success of this cover, coupled with the acceptance of the company's outboard motor shroud, is a clear indication of reinforced plastics' suitability for motor housings, both in terms of economy and functionality.—End

No matter what your product, you'll make it better, more easily and probably at lower cost with the use of

NEW IDEAS IN



1

2

The versatility of the extrusion process is an old story. Rigids, elastomerics, foams, films, laminates, and coatings can be extruded.

The economics of extrusion, (MPl, Nov. '57, p. 99) have also been well established. Tool costs in comparison to other methods of producing plastic parts are low.

On top of versatility and economics the application of product part design, engineering, specialized take-off and ingenuity in post-extrusion fabrication spells out economies, speed, and ease of assembly for manufacturers of practically all durable goods. Called by some people the "tricks" of extrusion, these methods are changing the process from an art to an engineering and design science. This article will deal only with case histories of rigid extrusions which point up the above statement.

1–The do-it-yourself package offered by Celluplastic Corp., Newark 5, N. J. The user simply cuts the tubing to any desired length and fits both ends with plastic plugs.

2–Bogen-Presto Co., a Div. of The Siegler Corp., found a way to make the dial scale on an AM-FM-amplifier tuner an integral part of the cabinet enclosure. It is a translucent white Plexiglas extrusion made by Anchor Plastics Co., Long Island City, N. Y., and is silk screened with numerals and a logging scale, indication being by a line of light produced by a movable light source behind the scale. The extrusion interlocks with a grey aluminum trim extrusion eliminating the need for screws or fasteners and reportedly lowering costs.

3

3–Croft Louisiana, Inc., manufacturers of aluminum windows, wanted to speed up shipments of fully-glazed windows and at the same time cut labor costs in putty glazing. For this account Texas Plastic Products Co., Houston, Texas, developed a "mutton bar" extrusion out of Cycolac which replaced the putty but fitted the standard aluminum channel. Whereas before this development at least a week was allowed for the putty to set, the new glazing strip permitted shipment on the same day. The window turned out to be much stronger than its predecessor, cleaner, and more attractive.

4

THE COVER: Several profiles as seen through a translucent acetate sheet. V-shape in center is from billboard frame shown on next page. Extrusions were supplied by Anchor Plastics Co., Commercial Plastics & Supply Corp., B. F. Goodrich.

RIGID EXTRUSIONS

4–An acrylic tube to increase the speed of making "white prints" on the copying machines of Rotolite Sales Corp., Stirling, N. J. This enables operators to see precisely when the paper development is completed after it has been processed in the copier. Extrusions were produced by Jessall Plastics Div., Electric Storage Battery Co., Kensington, Conn.

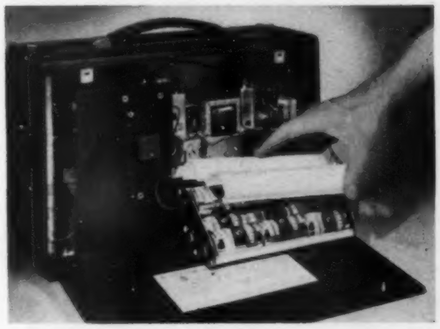
5–The battery case for an RCA Victor portable radio is an example of a most complex extrusion shape resulting in simplicity of application. The two halves of the case interlock and the extruded plastic rods are cemented into grooves of one shape and these are then heat formed so that they act as rivets to hold the end plate. Because of the quantity involved, injection molding would have been prohibitively costly. The extrusion and fabrication were done by Anchor Plastics Co. out of Bakelite high-impact styrene.

6–To carry small parts in production sequences without manual handling from one machine to another, Jessall Plastics produces as a proprietary item a clear Tenite acetate carrier tube. This is another do-it-yourself proposition because while the various sizes of tube are extruded as straight and rigid, they are cut to any desired length with an ordinary saw and may be shaped to any curve or bend by first packing with water soluble salt, then heating briefly to 180° F. and, after cooling, washing out the salt.

7–Beyond the post-fabricated straight extrusions there is the recent development of curved extrusions by Anchor Plastics Co. which eliminates the necessity of post-forming and enables undistorted curved moldings to be made. Applications include the insulation mounting of television tubes, as trim for circular mirrors, and any other place where curved sections or complex form are desirable.

8–Still another form of curved extrusion is an automatically coiled extrusion combining plastic and metal strip devised by Frank Plastics Corp., Detroit, Mich. This product is finding interest in the electronics field.

The combinations of metals with plastics in



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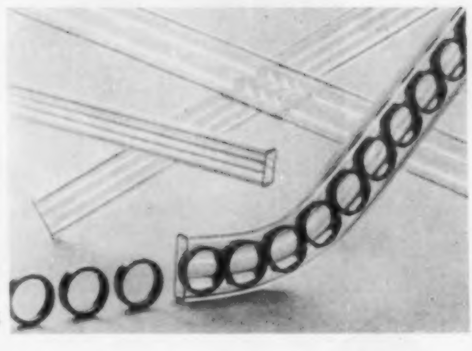

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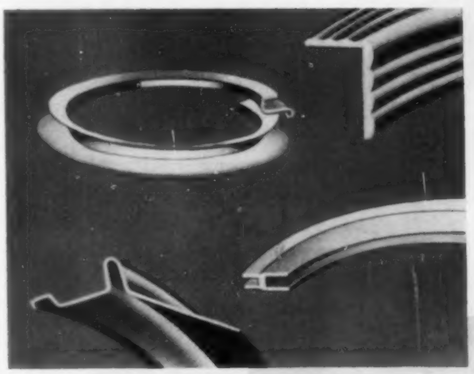

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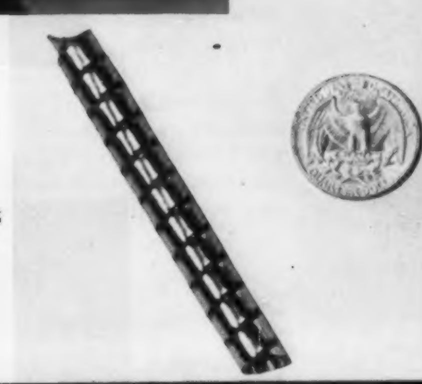

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extrusion are many. It is possible to make an ordinary extrusion of any shape and metallize it by vacuum deposition. It is also possible to use the process to laminate a transparent plastic to metal strip. And, finally, it is possible to extrude transparent plastic over any colored metal foil in a variety of shapes to literally produce an embedment which will never be subject to corrosion of any kind, and will never change its appearance.

9–Such a product is Silvatrim, produced by Glass Laboratories, Inc., Brooklyn, N. Y., which is beginning to supplant many types of metal molding now on the market for trimming and beautifying furniture, luggage, television sets, automobiles, and lampshades. This product is currently made from Eastman's Tenite butyrate exclusively because of the maker's desire for good weathering resistance.

10–A new version of the same material is produced in flat tape form with a pressure-sensitive adhesive on the back, which is protected by strip-off paper.

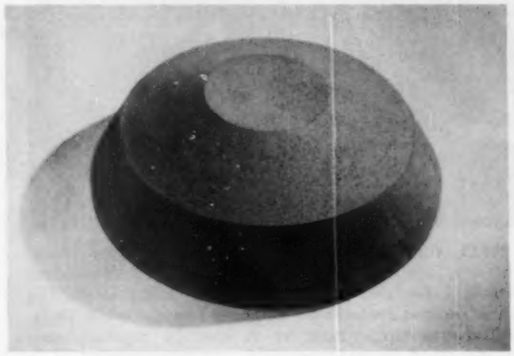
11–Replacing copper, this roof flashing costs about one-third less. Extruded by Southern Plastics Co., Columbia, S. C., for ROK Corp., Brecksville, Ohio, in a design controlled by ROK, the extrusion incorporates ribs that prevent water from being blown under the shingles. It is sold through local distributors for use in residential buildings. The material (Geon 8200A PVC) is reported not to burn. It is lightweight, fungus and mildew resistant, and will not corrode. Pre-slotted holes permit expansion and contraction during temperature changes, thus preventing warping.

12–Billboard frame extruded by Colonial Plastics, Cleveland, Ohio, of Geon 8700A grey PVC for the Central Outdoor Advertising Co., replaces wooden frames previously used. While initially more costly than the wooden structure, it eliminates all painting maintenance needs, and thus becomes more economical in the long run. This is especially true since the billboards are scattered all over the countryside, making periodic maintenance particularly costly. As is the case with the vinyl roof flashing described in 11, above, slotted holes in the high-impact material permit lateral movement and prevent buckling, even when the frame has been subjected to changing temperature.

This even dozen of recent rigid extrusions applications points to an opening door to new markets. In none of the above cases could the job have been done as satisfactorily and as economically by any other method.—End

#10, #11, #12, in a series

EVERYBODY NEEDS EPOXIES



RADAR LENSE machined on a lathe from a block of isotropic dielectric epoxy foam. These shapes (inside view, left; outside view, right) measure about 2 ft. in diameter. The foam has a density of 25 lb./cu. ft., but higher densities can be made.

Foam—newest member of versatile family

By H. S. Schnitzer* and Sven Richter*

Foamed epoxies add a new dimension of usefulness to these resins by making available their properties to lightweight structures.

In regard to commercial availability of epoxy foams, we have semi-finished shapes, that are foamed and cured blocks or slabs or sheets of varying density and a range of other physical properties, which are usually cut or machined by the user to the final desired shape. For those who want to do their own foaming—mostly to encase electronic parts or fill voids in structures—there are available a number of foamable compositions. Foamed-in-place compounds can be either in liquid or powder form. The latter, also called single-component mixtures, need only application of heat to rise to a foam. The liquid formulations are two-component systems that must be mixed before pouring and heating. There are also pack-in-place mixtures, which are lightweight aggregates that are wet by a solvent and can be tamped in place and cured to foam-like structures.

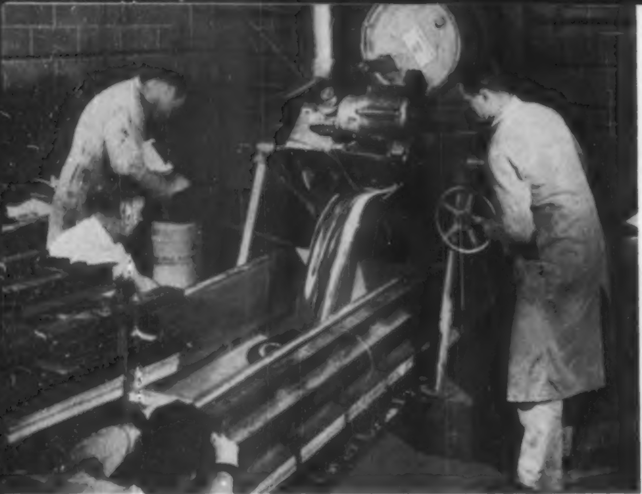
Most epoxy foams are rigid, but some can be called semi-rigid. No flexible epoxide foams are presently offered. These foams can be made either with open or closed cells, but the latter types are predominant because the applications in which epoxy foams excel demand exclusion of moisture.

*DeBell & Richardson, Inc., Hazardville, Conn.

How they are made

In general, epoxy foams are produced by dispersing a powdered chemical blowing agent in a liquid resin, adding a curing agent, then heating to a temperature sufficient to thermally decompose the blowing agent and initiate the resin cure. Surface-active agents are useful to modify and control cell size, and volatile organic liquids such as toluene have been added to absorb some of the exothermic heat evolved during the cure of the resin and at the same time to act as auxiliary blowing agent. Foam density is controlled by the proportions of blowing agent and volatile liquid in the composition, and densities as low as 2 lb./cu. ft. can be attained. Commercial foams usually range up to about 25 lb./cu. ft., but higher densities can be made.

In practice, and for large foams, the procedure just described is not as simple as it sounds. Also, since the foaming operation is essentially a modified casting process, the volume and configuration of the cavity being filled have con-



FOAMING MASS, consisting of epoxy resin, curing agent, modifiers, and blowing agent, is mixed and heated in steam-heated stainless, tiltable kettle and poured into mold (foreground). The heated, closable mold is coated with a special release agent. Technician at left checks temperature which must be carefully controlled. Foaming starts immediately and maximum expansion is reached in a matter of minutes. Technician in front gets ready to close mold as soon as pouring is completed.

siderable effect on the rate of heat dissipation during and after foaming, which in turn affect the quality of the foam.

The largest commercial foam blocks are about 8 by 2 by 1 ft. and at this size and with the high exotherm and low conductivity of the foam, it is a formidable task to avoid scorching and charring and cracking during the manufacturing process. Properties of epoxy foams can be varied and controlled by choosing appropriate resins, curing agents and modifiers. These foams have excellent machinability and tolerances of ±0.005 in. can be kept.

There is no warping or distortion (with no load) up to 150° C. Water absorption is low in closed-cell foams and will not significantly change dielectric properties. They possess good resistance to oils, greases, and solvents, and are relatively non-corrosive.

A disadvantage that is still only partly overcome is the rather high toxicity or at least sensitizing effect of uncured or curing epoxide systems. Cross-linked epoxides, either as laminates, coatings, or foam, appear to be rather innocuous. Aging characteristics must be termed very good, although light resistance of compositions containing aromatic diamines is quite poor, so that they darken or discolor, and a certain surface brittleness occurs on aging in air at about 125° C. for several months.

Epoxy foams are not inexpensive. The resins are in the 60 to 70 cents/lb. range, and curing agents and modifiers are at about the same level. Molds are costly and much manual labor is required.

Table I: Prices for prefoamed blocks[a]

Density lb./cu.ft.	*$/Pound*	*$/Cubic foot*	*$/Board foot*
5	6.36	31.80	2.65
10	3.77	37.70	3.14
13	3.10	40.30	3.36
15	2.92	43.80	3.65
20	2.48	49.60	4.13

Foams that are self-extinguishing or have highly isotropic dielectric properties are more costly.
[a]Dukafoam made by D&R Pilot Plants, Inc., Hazardville, Conn.

Where it is used?

A great many uses for epoxy foams have been enthusiastically proposed in reviews and technical literature. Out of these have emerged a small number of applications in which epoxy foams do an outstanding job, and the number of these applications will no doubt increase as technology continues to improve.

Present applications for epoxy foams include potting and encapsulating compounds for electrical components, usually in small unit volumes. Prepared compositions are available commercially for this type of application, either as one-component powder mixtures or two-component liquid systems which can be foamed by heating to about 110° C. Large pre-foamed blocks of epoxy foams are excellent bases for lightweight, strong, rigid, dimensionally-stable check jigs and fixtures in the aircraft field. In one case, replacement of a steel base plate by an epoxy foam slab 72 by 24 by 6 in. effected a saving in weight of about 400 pounds. Other uses for pre-foamed blocks or sheets include pattern and model making, insulation and flotation material. In these applications there is some competition from rigid polyurethane foams. Final properties of epoxy and urethane foams are about the same, although the former may have an edge in regard to water sensitivity and aging properties.

A particularly interesting and useful application for epoxy foams takes advantage of the unusually high degree of isotropy which can be attained in the manufacture of pre-foamed blocks. By careful choice and incorporation of metal powder fillers, isotropic, self-extinguishing foams having predetermined, controlled dielectrical characteristics can be made in large blocks, from which are machined lightweight lenses for radar navigational systems.—End

Epoxy-styrene foam—putting exotherm to work

By J. A. Struthers*

Combinations of low-molecular-weight epoxy resins, curing agents suitable for highly exothermic reaction, and expandable polystyrene beads develop unusual foam systems with the following characteristics:

1. Provides three- and four-component foam manufacture with expansion independent of an external source of heat.
2. Ability to fill molds of complex shape.
3. Capability of producing fibrous glass reinforced epoxy resin surface skins enclosing a low-density expanded polystyrene foam core for structural sandwiches.
4. Ability to bond, without adhesives, to many surfacing materials during expansion to produce sandwich constructions.
5. Produces molded parts with a density from 5 to 30 lb./cu. ft. which are rigid, structurally strong, and resistant to water absorption.

How it is done

Several different fabrication methods may be used to produce moldings from this system; however, the "prefoam" method appears best suited for commercial use. The expandable polystyrene is pre-expanded in conventional steam or radiant heat prefoamers to the desired bulk density—generally from 1½ to 5 lb./cu. foot. The dry pre-expanded beads are placed in a retaining mold which has been warmed to about 140° F. and prepared with the proper mold release system. The epoxy resin, curing agent, and modifier are intimately mixed for 30 sec. and poured or pressure-fed over the beads in the mold cavity.

Briefly, the exothermic reaction between the epoxy resin and the curing agent provides heat to cause further expansion of the beads.

The molding produced by this method consists of a surface of cured epoxy resin enclosing an expanded polystyrene foam core, with small amounts of resin surrounding each bead. The molding is unicellular, has good insulation quality, and very low water absorption. Heat resistance ranges up to 160° F., and mold shrinkage may be described as negligible.

Moldings with a thickness greater than ¾ in. can be readily produced. Thinner sections are difficult to mold without resorting to very high weight ratios of epoxy resin to expandable polystyrene and high charge densities.

This system utilizes the excellent adhesive properties of epoxy resins in order to produce sandwich constructions.

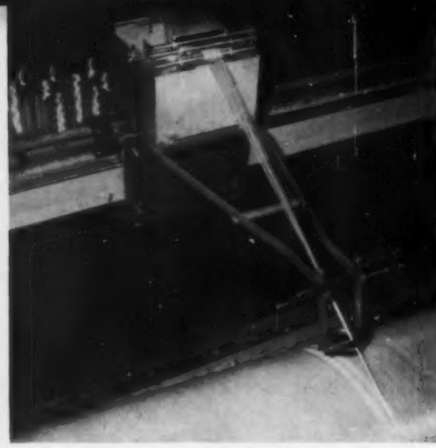
When glass fabric or mat are used, the pressure developed (10 to 35 p.s.i.) by the expanding polystyrene beads is sufficient to cause the epoxy resin to saturate one or more layers of fibrous glass. This produces a glass reinforced epoxy resin laminate surface enclosing an expanded polystyrene foam core.

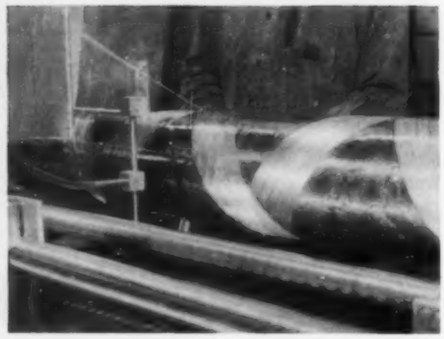
Polyester and epoxy gel coats may be used to obtain a variety of colors, textures, and surface appearances, by applying them to the mold surface prior to molding. This results in a structural sandwich with the desired surface appearance produced in one molding operation.

The most promising applications for this system are structural flotation devices, such as water skis, buoys, boat hulls, and surfboards. In addition, desk tops, insulated boxes, structural panels, and bathroom fixtures are currently being investigated.—End

MOLDED light housings, using colored resin (left) or plain beads (right), have molded-in ring to which a light diffuser is attached.

* Plastics Technical Service, The Dow Chemical Co.
This system, and its various aspects, is the subject of pending patent applications of The Dow Chemical Co.





OVER-ALL VIEW of filament winding operation (left). In foreground is creel from which strands of glass fiber are drawn (up to 100 spools can be accommodated). In rear is mandrel where filament winding takes place. Box-like structure to right of operator contains epoxy-hardener formulation through which strands travel for impregnation. Close-up of impregnating unit (upper right), shows how individual glass strands are gathered and wound onto mandrel. Typical winding pattern for rocket engine is shown at lower right. Excess of resin-hardener mixture, dripping off mandrel, is collected and can be reused.

EPOXIES

Rocket motors—epoxy pipe glamorized

Unlike those which normally come to mind, rocket motors are, in effect, no more than cylindrical casings for solid fuel propellant, with a nozzle-like opening at one end. In other words, they are essentially pipe-like structures. However, they must possess high heat resistance because the fuel burns right to the wall of the cylinder, and they require tremendous burst strength. Hoop stresses up to 120,000 p.s.i. have been measured, and have been successfully withstood by the plastic cases. Techniques used for rocket motors are equally applicable to production of reinforced epoxy pipe.

At Lamtex Industries, Inc., Farmingdale, N. Y., where the motor cases illustrated in the accompanying photos are produced, a method which greatly enhances the physical properties of the finished product is used. Instead of using glass sleeving or other forms of woven glass, individual strands of glass fiber are wound onto a mandrel, and impregnated with an epoxy-anhydride formulation. Up to 100 strands may be wound at one time, constantly criss-crossing from one end of the mandrel to the other. The angle of the lay is important; it affects the amount of resin and hardener required as well as the final strength of the cured laminate.

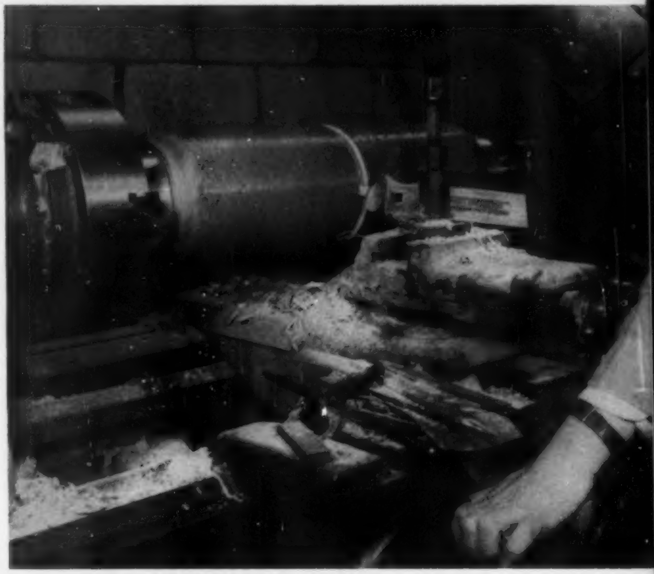
Resins used are Shell's Epon 820 and Ciba's Araldite; the curing agent is Allied Chemical's National Aniline Div.'s Nadic methyl anhydride; glass by O-C Fiberglas.

The same basic properties—high strength,

low weight—which are desirable in missile work and in the production of pipe make the filament-wound anhydride-cured epoxies a good engineering material in many other applications as well.

For example, a circuit-breaker liner, built for a major electrical equipment manufacturer, is some 10 ft. long and tapers from 3 to 2 ft. in diameter. It protects the ceramic component of the circuit breaker against shattering in case of an internal explosion. The plastic liner will absorb all stresses, and reduce the damage which would otherwise result. The laminate has excellent dielectric properties, and may be used in numerous other types of heavy electrical apparatus.

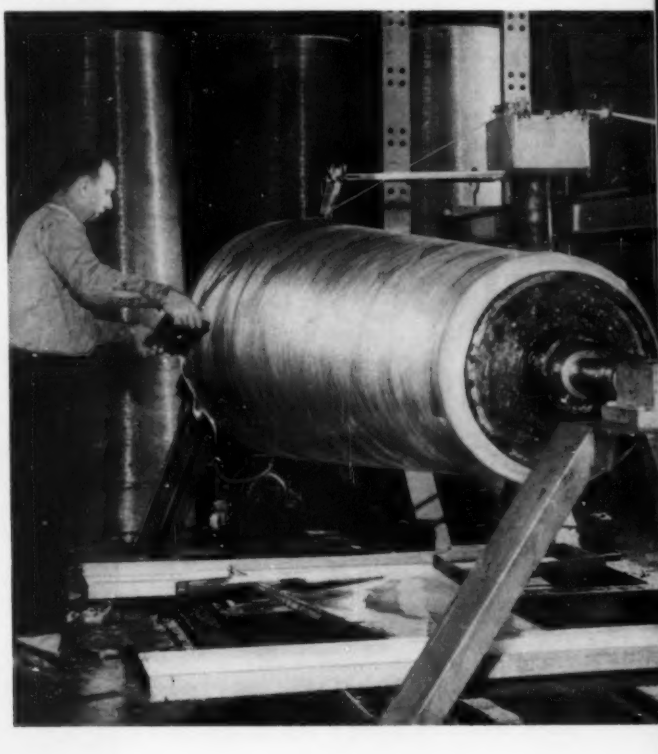
The same methods may be used to fabricate bottles or containers for extremely high pressures—such as those used to store liquid helium in missiles. Radomes and nose cones have also been fabricated by this technique, as have commutator parts, tubing for aircraft electronic fuel gages, and similar equipment.—**End**



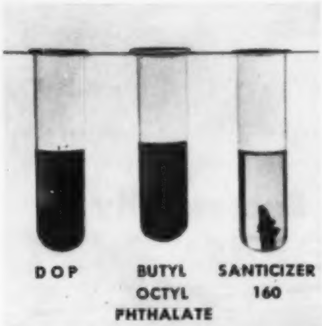
EPOXY-GLASS laminate, which is machinable on conventional equipment, is pictured being grooved for mating with another part.

ROCKET MOTORS made by filament winding process. Essentially, the same method is used to make pipe, pressure vessels, and similar items.

LARGE, cone-like section will form part of a heavy-duty circuit breaker, and serves to absorb impact in case of internal explosion. "Cone" tapers from 3-ft. diameter at far end to 2 ft. at nearest point.



Santicizer 160 gives you... IMPROVED PROPERTIES IN TILE



SANTICIZER 160 shows low migration to asphalt by insignificant pickup of black color from asphalt-impregnated felt, can prevent buckling of tile by migration to adhesive.

Staining tests show that SANTICIZER 160 provides best resistance to asphalt staining and the other big troublemakers like mustard, catsup, lipstick, tar, and kitchen grease.

If you want to stop customer complaints about staining, loss of adhesion, and buckling of tile by plasticizer migration to adhesive, use SANTICIZER 160. Even if your own adhesive works satisfactorily, you can't be sure a customer will use *your* adhesive with *your* tile. When you use SANTICIZER 160, you'll also boost consumer acceptance with these added benefits:

"Three-dimensional" gloss • High abrasion resistance • Excellent dimensional stability • Good resistance to extraction and hydrolysis

FASTER, MORE ECONOMICAL PROCESSING

	PROCESSIBILITY			FILLER TOLERANCE					
Plasticizers	Time to reach 280° F.	Plasticity on roll mill	Tack	Plasticity with fillers (parts filler) 100	115	125	Tack with fillers (parts filler) 100	115	125
SANTICIZER 160	2 min., 3 sec.	E	E	E	G	F	E	G	F
DOP	2 min., 35 sec.	VG	G	VG	F to P	*	G	F to P	*
BUTYL OCTYL PHTHALATE (SANTICIZER 165)	2 min., 15 sec.	E	G	E	F	P	G	F	F

E—Excellent, VG—Very Good, G—Good, F—Fair, P—Poor. *Batch dropped from mill. Formulation available on request.

Step up production and cut down processing delays with SANTICIZER 160. Compare its advantages in processing with any other plasticizer... none can match these important benefits:

HIGH WETTING ACTION—allows higher filler use with homogeneous mixtures and best gloss

GOOD PLASTICITY AND FAST FUSION—for fastest processing

QUICK TACK—for easy milling, surface gloss, and roll retention (no fall-off)

UNIFORM RESULTS—for "leveling out" the effect of variations in processing

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The many advantages of SANTICIZER 160 make it your best buy in floor-tile plasticizers. If your formulation calls for a plasticizer blend (such as SANTICIZER 160 with DOP, DIDP, or SANTICIZER 165), Monsanto *custom blends* in bulk offer you these important advantages:

- You can reduce ordering, handling, storage, and blending expenses
- You achieve standard, uniform mixtures and eliminate chances of weighing errors, contamination, spillage
- You obtain the lowest bulk price on ingredients

Conserve your working capital by blend service from Monsanto. Monsanto stocks floor-tile plasticizers at *six* bulk stations, *13* warehouses, and *two* plants. They're located for fast delivery to your plant.

For more information or a SANTICIZER 160 sample, contact your Monsanto representative.

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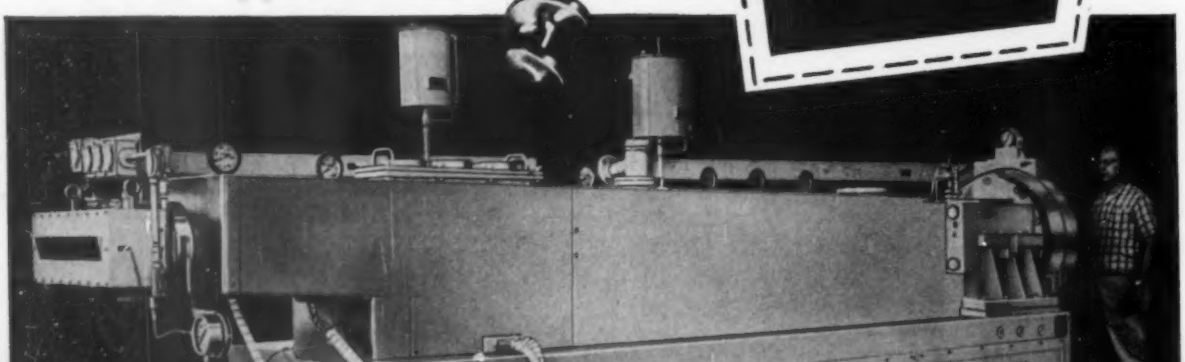

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The elastic melt extruder—works <u>without screw</u>

By Bryce Maxwell[†] and Anthony J. Scalora[‡]

A truly unique plastics extrusion machine has been developed which has no screw. The movement of material through this machine is based on a radically new design using the centripetal pumping action which can be developed from the rotary shearing of visco-elastic melts.

The principal operating variables of the elastic melt extruder have been studied on lab-scale models, and the experimental results are reported here for comparison with conventional screw extruder data and as a guide for further prototype development which is already under way in industrial labs.

Chief uses foreseen for the elastic melt extruder will probably be in profile and foam extrusions, wire coating, pipe, and as a mixer in compounding plastic materials. It is still too early to tell if it will also extrude films.

Of particular interest to processors of heat sensitive materials is the short time material remains in the machine; less than 9 seconds! Also of considerable interest is the ability of the machine to dry or degas materials while extruding; by proper adjustment, bubble free styrene extrusions can be made from a foaming polystyrene feed. Undoubtedly, this extruder will open up new horizons in the extrusion of plastic materials.

Plastics extrusion machines are called upon to do several operations simultaneously: heating and fluxing of polymers, transporting of materials, mixing or compounding of materials, and forming of material into shapes by forcing it through a die. The conventional screw extruders do all of these individual operations with various degrees of efficiency. An analysis of current screw extrusion methods available to the plastics industry indicates the areas in which improved performance of these tasks is needed.

Many screw extruders transfer a large proportion of the heat needed to plasticate the polymer by conduction from the walls of the extruder barrel and the surface of the screw. Since polymers are by nature good thermal insulators, heating by conduction requires that the material remain in the machine for a prolonged period of time. Typical values of residence time are usually in the range of minutes.

To improve heat transfer to the material being processed, zones along the extruder cylinder are sometimes heated to a temperature which is greater locally than the average temperature desired for the material by the time it is plasticated and extruded through the die. This increased temperature differential between the hot wall and the cold polymer improves heat transfer but also introduces the possibility of thermal degradation in heat-sensitive polymers during long residence times in the extruder.

It would be desirable to minimize the time the hot material is in the extruder and also put as much of the required heat into the material by means of mechanical energy. Since mechanical working will generate heat in the material uniformly throughout the

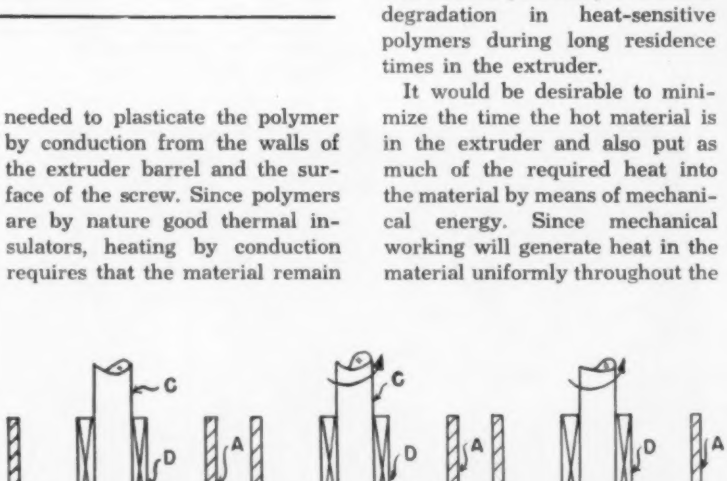

FIG. 1: Schematic drawings of apparatus demonstrating the normal pressure effect on visco-elastic material.

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‡Group Leader, Plastic Process Development Group, Owens-Illinois Glass Co., Toledo, Ohio.

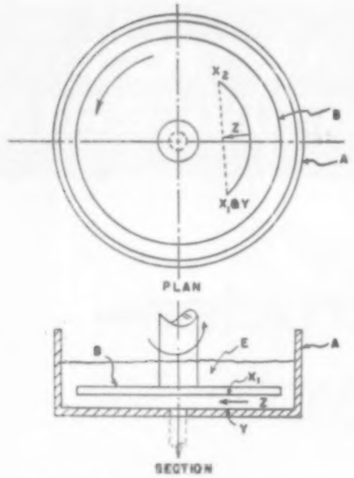


FIG. 2: Schematic representation of the cause of the normal pressure effect.

mass as it is being worked, the heating rate will increase and the residence time can be reduced. If it is also necessary to introduce heat by conduction, the cross-sectional distance that the heat must travel through the polymer should be reduced to a minimum.

Another problem which sometimes occurs in the screw extruder is the fluctuation of pressure at the die. In order to achieve steady-state conditions at high throughput rates, careful consideration must be given to the design of the screw for each type of material. Pressure fluctuations can result if screws are operated under machine conditions for which they were not designed or with materials with characteristics not suitable for a particular screw design. In addition, flighted screws will also introduce pressure fluctuations at the die.

Besides the forming of materials into desired shapes, screw extrusion is also used as a processing tool for mixing and compounding. Maddock(1)[1] has recently shown that only a small proportion of the material volume in the flights of the screw is undergoing mixing and that in order to achieve uniform compounding the screw must be lengthened significantly to assure proper mixing. For good compounding and dispersion it is necessary that all material passing through the extruder be subjected to the same concentrated intensive shearing. This can be done best by passing the material through a region in the machine where there is rapid relative motion taking place between thinly separated surfaces.

In view of these problems it appeared desirable to explore the use of some extrusion machine other than a screw extruder. Such a device is described in this article. Extrusion is accomplished using a principle based on the elastic nature of polymer melts. Although the elasticity of melts gives rise to non-Newtonian behavior which complicates the analysis and design of screw extruders, this elastic character is highly desirable and used to advantage in this new method of extrusion.

[1]Numbers in parentheses link to references at end of article, p. 210.

Basic theory

The elastic melt extruder herein is based on the use of a natural phenomenon called the normal force effect (2, 3), in particular, the normal force developed when a visco-elastic material is sheared between a rotating plate and a stationary plate. This effect is illustrated in Fig. 1, p. 107.

Referring to Fig. 1A, a fixed cup *A*, has a rotating disk *B*, mounted on a shaft *C*, inside the cup. Shaft *C* is free to rotate and also free to move vertically in the bearings, *D*. If an appropriate liquid is placed in the cup and the disk is rotated, the situation shown in Fig. 1B will result. That is, the liquid will be pulled into the space between the disk and the fixed cup forcing the disk to rise against the force of gravity. This force is perpendicular to the shearing stress and, hence, is called the normal force.

This force effect has been studied for many liquids and solutions. Pure Newtonian liquids do not seem to exhibit the effect but liquids and solutions which respond to shearing in an elastic as well as viscous manner have been found to give the normal force effect. This phenomenon has been the subject of considerable academic interest and much has been written concerning the origin of this force.

However, we are not concerned here with the cause of the normal force but rather with the presentation of a mechanism which utilizes this phenomenon for the purpose of extrusion. Referring to Fig. 1C, a schematic drawing of a device for doing this is presented. Here the rotor is restricted from rising by the shoulder on the shaft *C*, which is forced against the bearing *D* by the normal pressure effect. If an outlet is cut in the bottom of the cup, the normal pressure effect will then cause an extrusion of the material through the outlet as the disk is rotated.

Two questions must be resolved in order to usefully apply this principle to the extrusion of poly-

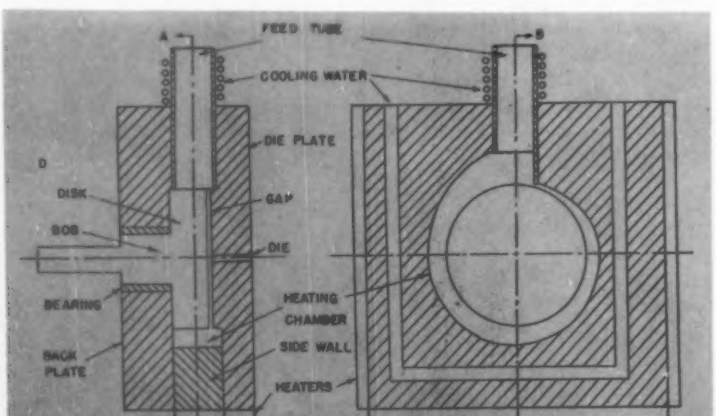


FIG. 3. Cross-sectional views of apparatus designed for extrusion of polymers using the normal pressure effect.

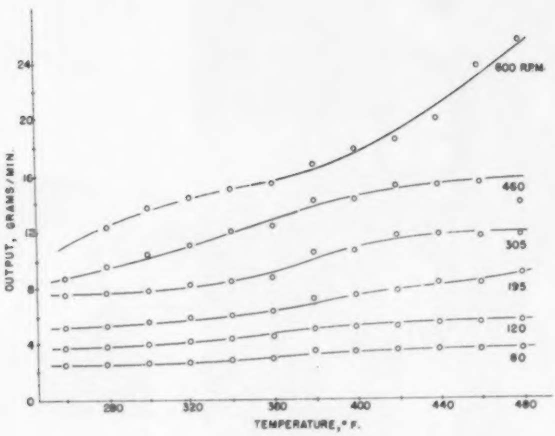


FIG. 4: Extrusion output as a function of r.p.m. and temperature; 1/32-in. gap.

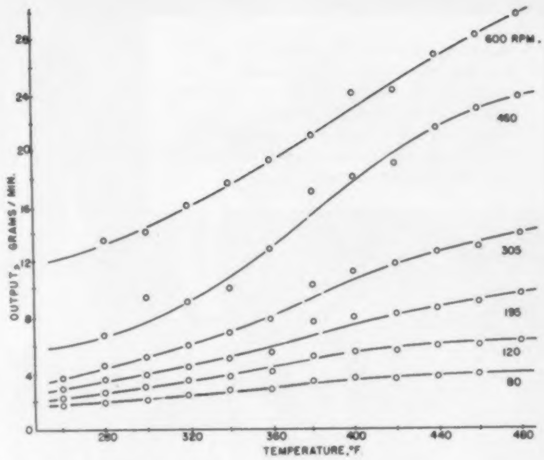


FIG. 5: Extrusion output as a function of r.p.m. and temperature; 1/16-in. gap.

mer melts. First, do polymer melts exhibit the normal force effect, and second, how shall new material be fed or introduced into the shearing zone? Normal force experiments reported in the literature using apparatus similar to Figs. 1A and 1B, deal primarily with measurements on liquids and dilute solutions in which the magnitude of the force measured was rather small and often amounted to just a small increase in a gravitational head or a small reduction in centrifugal force. The data presented below indicate that with polymer melts, much greater normal forces and extrusion pressures can be developed. The introduction of new material into the shearing zone is also discussed and two solutions to this problem are presented.

Driving force for new method

Although there is not complete agreement in the literature as to the cause of the normal pressure effect, the schematic picture presented in Fig. 2, p. 108, may be helpful in understanding the driving force in this new extrusion technique. Let X_1 represent a point on the bottom surface of the rotating disk and Y represent a point on the inner surface of the bottom of the fixed cup, directly below X_1 at any given instant of time. Then at some time later, X_1 will have moved to some position X_2 along the curved path X_1-X_2. Assuming that the liquid E adheres to the surfaces at X_1 and Y, and that the liquid is partially elastic, then it will be stretched along the path X_1-X_2. In one sense, the elastic behavior of the liquid is like the stretching of a rubber band along the curved path X_1-X_2, and the tendency for elastic recovery gives rise to a force toward the center of rotation represented by the arrow Z. This force toward the center of rotation, or centripetal force, which is generated in, and acts on the material, gives rise to a pressure between the cup and the rotating disk. This pressure acting in the gap creates the normal force tending to separate the plates.

The centripetal force Z gives rise to a centripetal flow. Since the entire area under the rotating disk contributes to the centripetal pumping action, the material through-put of the extruder is not limited by the pressure developed but rather by the centripetal pumping action itself. From the rubber band analogy it becomes apparent that the proper combination of elastic and viscous response, and the wettability of the surfaces of the disk and cup by the liquid is necessary for extrusion by this method. The greater the elastic character of the liquid, the greater the centripetal pumping action. The lower the apparent viscosity of the liquid, the less restriction there will be to the flow of the material. For this reason the method of extrusion described here is called *elastic melt extrusion* or *rheolastic extrusion*.

Viscous and elastic characteristics of polymer melts have been studied by several methods(4). In general as the rate of shear of the melt is increased, the response of the material becomes more and more elastic. That is, as the straining rate increases with respect to the relaxation times **(To page 112)**

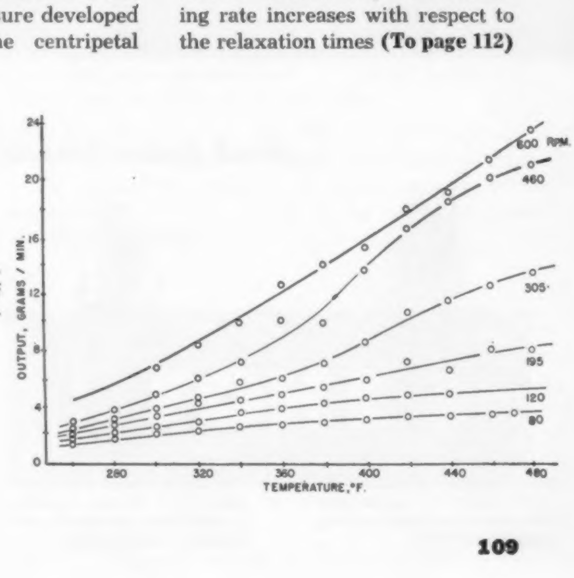
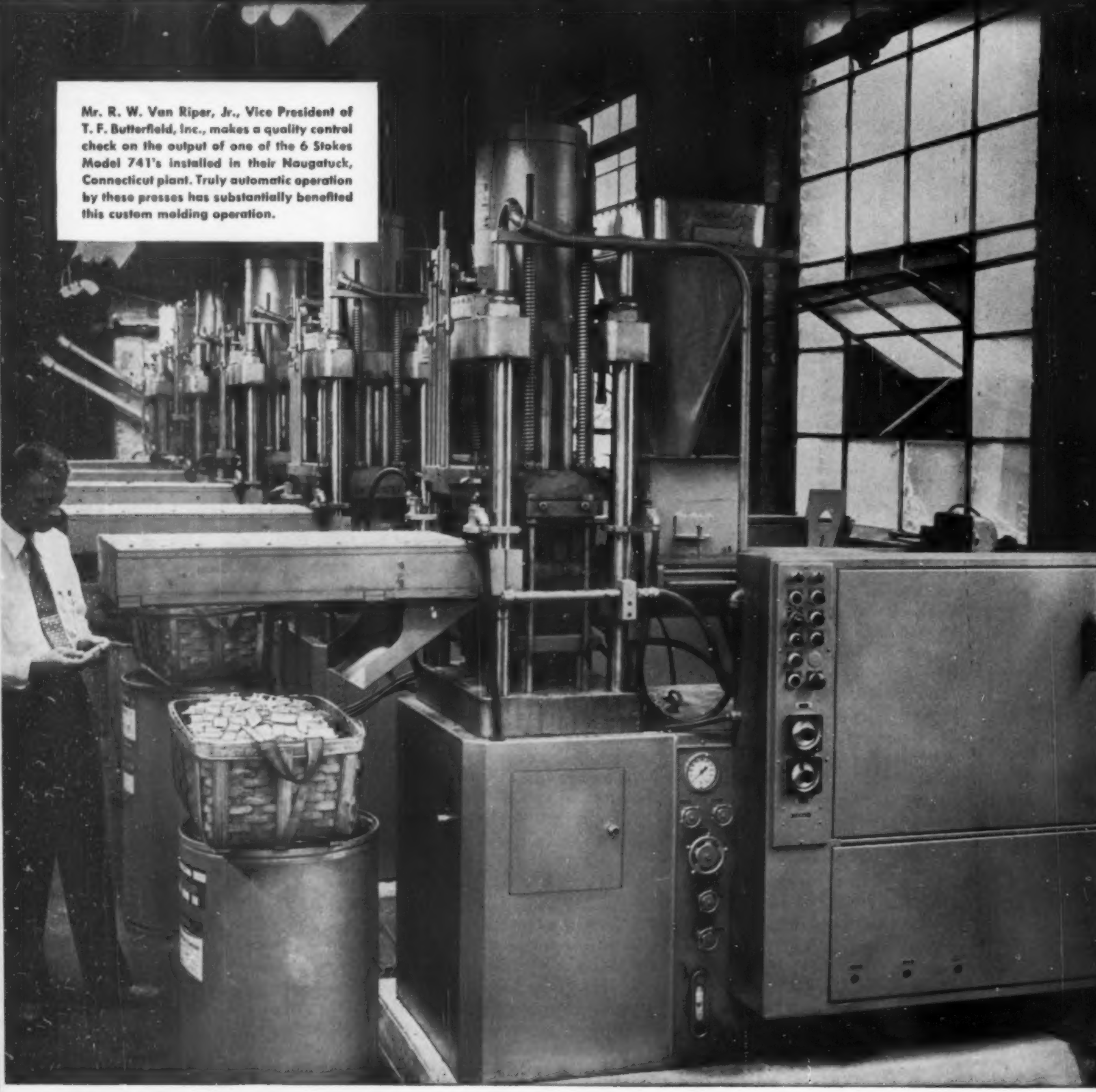
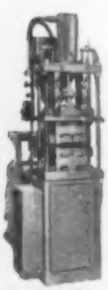


FIG. 6: Extrusion output as a function of r.p.m. and temperature; 1/8-inch gap.

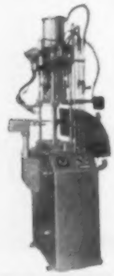


Mr. R. W. Van Riper, Jr., Vice President of T. F. Butterfield, Inc., makes a quality control check on the output of one of the 6 Stokes Model 741's installed in their Naugatuck, Connecticut plant. Truly automatic operation by these presses has substantially benefited this custom molding operation.

OTHER STOKES PRESSES FOR THERMOSET MOLDING

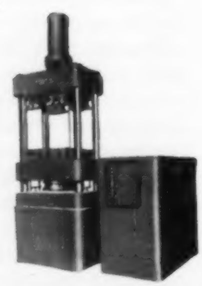


The Stokes Model 800 automatic . . . 15 and 25 ton models. Has all the advanced features of the larger Model 741's.



The Stokes Model 725 automatic . . . 25-ton capacity. A simple low cost machine for varying production runs.

The Stokes Model 726 semi-automatic compression molding press. 50, 100, 200 and 300 ton models.



The Stokes Model 727 semi-automatic transfer molding press. 50, 100, 200 and 300 ton models.

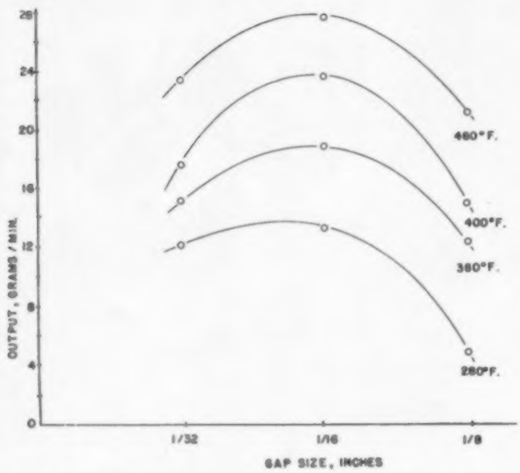


FIG. 7: Output as a function of gap size at various temperatures at 600 r.p.m.

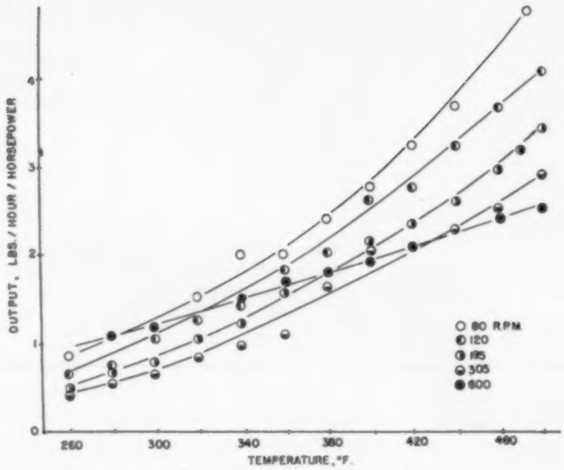


FIG. 8: Pounds per hour per horsepower as a function of temperature and r.p.m. at $\frac{1}{16}$-in. gap size.

of the cohesive forces in the material, the material exhibits more elastic behavior. If the response of the material was completely elastic, the normal force would still appear as shown by Poynting (5) for elastic solids, but no flow would take place. A proper balance of elastic and viscous behavior must be reached by controlling the shear rate in the extrusion device to obtain the maximum output rate for a polymer melt at a given temperature.

The shear rate may be controlled by varying the rate of rotation of the disk, the disk diameter, or the gap between the disk and the bottom of the cup. These design features must also be coordinated with changes in the response of the polymer melt with temperature.

Apparatus

Figure 1 shows the apparatus required to demonstrate the normal force effect operating in a vertical position. In order to eliminate the gravity head from our measurements and to assist in feeding material, the apparatus used for this study was operated horizontally. This has no effect on the basic principle.

Figure 3A, p. 108, shows a vertical section through the axis of rotation of the disk or bob. Figure 3B shows a vertical section perpendicular to the axis of rotation. A 1-hp. a.-c. motor coupled to the bob through reduction pulleys was used to drive the disk. Heating was provided by electrical resistance heater bands clamped on the exterior of the case. The feed tube or "hopper" was cooled by water circulating in a cooling coil. For these conditions of operation, more heat was generated by mechanical working than was desired, so cooling water was also circulated in channels in the case. Temperatures were measured using a thermocouple and recording potentiometer with the thermocouple located as close as possible to the melt shearing zone in the die plate. Power input was determined with a watt-meter.

The heating chamber, or melt reservoir, was constructed in three parts. A 6-in. diam. circular back plate served as the rear wall of the heating chamber and also as the bearing mounting for the rotating bob. The side wall of the chamber was made from an aluminum plate. The shape of the heating chamber was such as to produce a convolute spiral around the bob for the purpose of feeding polymer into the shearing zone. A third circular die plate formed the front wall of the heating chamber also acting as the stationary shearing surface and the extrusion die. The disk was $2\frac{3}{4}$ in. in diameter.

Test procedure

The test procedure used was as follows: After the die plate with the required gap size was bolted to the heating chamber assembly, the apparatus was then heated to about 300° F. Even when planning to operate under adiabatic conditions it was necessary to heat the apparatus above the softening point of the polymer in order to start operation. During the heating period, polymer granules were placed in the heating chamber. When the granules had softened, the extruder was started. Polymer granules were fed continuously through the hopper.

By adjusting the power supplied to the heaters and controlling the

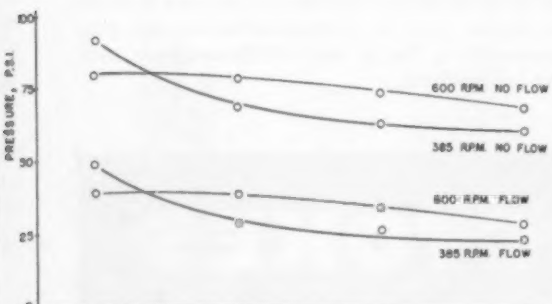


FIG. 9: Extrusion pressure expressed as a function of temperature at $\frac{1}{16}$-in. gap size.

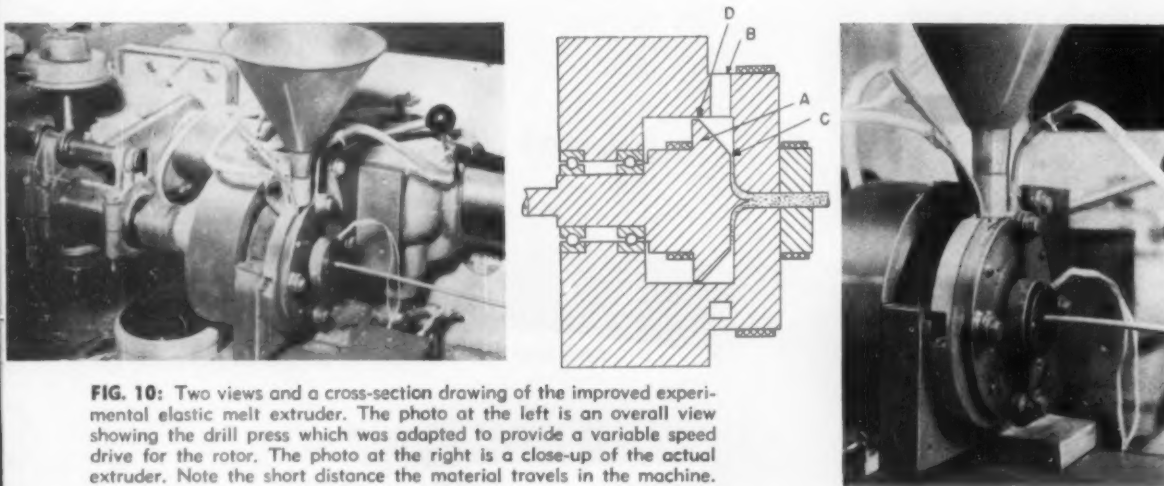


FIG. 10: Two views and a cross-section drawing of the improved experimental elastic melt extruder. The photo at the left is an overall view showing the drill press which was adapted to provide a variable speed drive for the rotor. The photo at the right is a close-up of the actual extruder. Note the short distance the material travels in the machine.

cooling water, the desired operating temperature was established and maintained. Enough polymer was continually added to keep a rolling bank of melt in the bottom of the feed tube and the time to collect the extrudate was recorded. The power consumed by the drive motor was measured during each run at a time when no solid granules were in the melt reservoir; however a rolling bank of melt covering at least ¾ of the bottom area of the feed tube was carefully maintained. This procedure was chosen so that constant readings could be obtained. If solid granules were present in the shearing zone abnormally high, irregular readings would have occurred. It should be pointed out that in the device shown in Fig. 3, it is possible for polymer melt to be forced by the feed system back into the area between the back of the rotating bob and the back plate and from there into the bushing.

Since the power measurements are the sum of the power needed to shear the material and the power lost due to the inefficiency of the drive motor, the power consumption data reported should be looked upon as relative rather than absolute values of energy required to extrude under the various conditions described.

Table I: Materials tried in new extruder

Material	*Form of feed*
Low-density polyethylene	Flake or granules
High-density polyethylene	Flake or granules
High-impact polystyrene	Granules
Polymethyl methacrylate	Granules
Plasticized polyvinyl chloride	Granules
Polypropylene	Flake or granules
Cellulose acetate	Granules
Foam polystyrene	Beads
Carbon black-filled polyethylene	Powder dry blend
Cross-linked polyethylene	Dry blend

Results

The output as a function of rotational speed, temperature and gap size is shown in Figs. 4, 5, and 6, p. 109. All of these tests were carried out using standard extrusion grades of branched polyethylene (melt-index 0.2-21.0, density 0.92) and were extruded through a ⅛ in. diameter by ½ in. long die opening.

The same general trend of increased output with increased temperature and r.p.m. is found for each gap size over the ranges studied. As the temperature of the polymer melt is increased, two changes in the mechanical response of the material occur simultaneously. The elastic response and viscosity are both decreasing. Since the centripetal pumping action of the normal force effect is dependent on the elastic response and is retarded by the viscous response, it is apparent from Figs. 4, 5, and 6 that the decrease in viscosity is predominant over the decrease in elastic response in the range studied. At temperatures above 500° F., it would be expected that even the high r.p.m. curves would level off or perhaps decrease as the melt approached the character of a purely viscous liquid.

The effect of gap size on output at various temperatures at 600 r.p.m. is shown in Fig. 7, p. 112. At each temperature there is an optimum gap size for maximum output. This is consistent with the picture of the centripetal pumping action presented in Fig. 2. For small gap sizes the normal force effect is high but the centripetal flow is strongly restricted by the small space between the rotor and the face plate. As the gap size is increased the pumping action is still strong and the flow is less restricted, hence output increases. Above some limiting value of gap size the normal force decreases since the distance between X_1 and Y (Fig. 2) becomes too great for the elastic behavior to be prominent and the output decreases.

Temperature, speed, and power

Power consumption as a function of temperature and r.p.m. is shown in Fig. 8, **(To page 202)**

Injection molding:

a rheological interpretation—Part 2

Experimental equipment, procedures, and an analysis of results in terms of the theory presented last month

By R. L. Ballman,* Tevis Shusman,* and H. L. Toor**

The distance-time relationship in the die was obtained by measuring the length of flow into a cavity as a function of the ram forward time, (RFT), the time being measured from the instant the ram started forward until it was stopped by releasing the hydraulic pressure on the ram. Assuming that no further flow into the cavity takes the place after releasing the ram pressure, the flow distance equals the length of the molding at the moment of pressure release. This assumption was checked by extruding melt out of the nozzle of the cylinder in the absence of a die. When the ram pressure was relieved, the flow stopped very rapidly and, since the resistance with the die is much greater than without it, we concluded that the flow into the die after pressure release *is* negligible. This method was chosen in preference to measuring the ram velocity because of complications introduced by the compressibility of the large mass of polymer in the heating cylinder.

Equipment

One of the two injection machines used was a 3-oz. Fellows Model 330-125 with an extra long heating cylinder and an extra hydraulic pump. The maximum ram pressure was 18,300 p.s.i. and the rated melt delivery rate was 68 cc./sec. Additional booster pumps rated at a total of 134 cc./sec. were used at the start of all runs and could be automatically cut out at any predetermined pressure or left in during the entire run of the experiment.

The other machine was an 8-oz. Reed-Prentice Model 100-8 with maximum ram pressure of 14,400 p.s.i., rated polymer delivery rate of 19.4 cc./sec. and a booster delivery rate of 224 cc./sec.

The effect of the booster was to vary the rate of build up of the ram pressure. On both machines the ram forward time could be controlled to ± 0.05 sec. by a timer which released the pressure on the ram a predetermined time after the start of the ram motion. The cylinder temperatures were controlled to $\pm 0.5°$ F.; ram pressures could be set to ± 100 p.s.i.

The die was designed with interchangeable parts so that various cavity thicknesses, channels and flow paths could be used. It is shown in Fig. 3, p. 107 of Part 1.[1] The sprue was a 2-in. long tube whose diameter varied from 0.2 to 0.3 inch.

Procedures

The polymer entered the sprue perpendicular to the plane of the drawing, flowed into the half-round runner and then entered the bar cavity on the left of the drawing. The connection between the runner and cavity was, unless otherwise stated, a "fan gate" with a rectangular cross-section 0.12 in. thick.

The cavities were all bars, 1.00 in. wide, 12 in. long; their thicknesses were 0.15, 0.075, and 0.05 inch. These width-to-thickness ratios should be large enough for the velocity profile in the wide plane to be negligible. In Position one, the flow was confined to the first cavity at the left of the drawing and in Position two, the flow passed through the first cavity (in this position the first cavity was always the 0.15-in. bar), and connecting channels and entered the second 0.075-in. bar.

The die temperature was controlled to within $\pm 2°$ F. by water which was circulated through the cavities and runners and, finally, a constant temperature bath.

Most of the runs were made with polystyrene, Compound B in Figs. 1 and 2, pp. 106-107 of Part 1. The rheological data shown in the figures are correlated approximately by Eqs. 1 p. 106, and 2, p. 108 of Part 1, with the constants given in Table I, left. Polyethylene was also used.

The cylinder and die temperatures were set to the desired values and the hydraulic system was started at least 30 min. before the beginning of a run. The overall molding cycle was timed at 65 sec. and the mold closed time at 30 seconds. These values were held constant for all runs by varying the mold-open time with RFT so that their sum would remain constant.

The amount of solid polymer

Table I: Rheological constants of polystyrene (Compound B)

$$n = 2.7$$
$$A^{*} = 111.5\ (\text{sec.})^{-1}\left(\frac{\text{in.}^2}{\text{lb.}}\right)^{2.7}$$
$$b = 1203°\ \text{F.}$$
$$T^{0} = 150°\ \text{F.}$$

[1]Part 1 of this article, dealing with theory and the statement of the experimental problem, appeared in MPI, Sept. 1959, p. 105.

*Research Dept., Monsanto Chemical Co., Springfield, Mass. Mr. Shusman's name erroneously omitted from Part I.
**Associate Professor, Carnegie Institute of Technology, Pittsburgh 13, Pa.

fed to the cylinder was varied so that the total polymer present in the cylinder at the start of each molding cycle remained constant.

The ram-forward time was then turned to some arbitrarily high setting, the ram pressure was adjusted to the desired value and molding was begun. The bar from each shot was measured to the nearest millimeter, the lengths of 10 successive moldings were averaged, and molding was continued without interruption until three successive averages differed by not more than one millimeter. This was accepted as equilibrium and the last three averages were in turn averaged to obtain the experimental value. For most runs it took at least 2 hr. to achieve equilibrium. Then ram-forward time was reduced by an arbitrary amount, the die-open time was increased by a like value, and the above procedure was repeated to obtain the second datum point. The time required to reach equilibrium for this and subsequent shorter RFT values was somewhat less than for the initial point. The RFT was repeatedly decreased until no plas-

Table II: Experimental operating conditions

Run No.	*Press*	*Cavity thickness*	*Die position*	*Cylinder temperature*	*Die temperature*	*Applied ram pressure* $\times 10^{-3}$
	oz.	*in.*		*°F.*	*°F.*	*p.s.i.*
1	3	.075	1	375	190	16.3
2	3	.150	1	350	70	18.3
3	3	.150	1	365	70	18.3
4	3	.050	1	350	70	18.3
5	3	.050	1	400	70	18.3
6	3	.050	1	450	70	18.3
7	3	.050	1	500	70	18.3
8	3	.075	1	340	80	18.3
9	3	.075	1	350	80	18.3
10	3	.075	1	375	80	18.3
11	3	.075	1	375	80	12.2
12	3	.075	1	400	80	12.2
13	3	.075	1	400	80	14.2
14	3	.075	1	400	80	18.3
15	3	.075	1	350	80	18.3
16	3	.075	1	350	130	18.3
17	3	.075	1	350	180	18.3
18	3	.150	1	335	80	18.3
19	3	.150	1	345	80	18.3
20	3	.150	1	345	80	18.3
21	3	.150	1	355	80	18.3
26	3	.075	2	425	80	18.3
27	3	.075	1	425	80	18.3
28	3	.075	2	475	80	18.3
29*	3	.075	2	425	80	18.3
30*	3	.075	2	475	80	18.3
31	8	.075	2	425	80	14.4
32	8	.075	2	475	80	14.4
33*	8	.075	2	475	80	14.4
34*	8	.075	2	425	80	14.4
35*	8	.075	2	450	80	14.4
36	3	.075	2	400	80	18.3
37*	3	.075	2	400	80	18.3
38*	3	.075	2	440	80	18.3
39*	8	.075	2	400	80	14.4
40	8	.075	2	425	80	14.4
41*	3	.075	2	400	80	18.3
42	3	.075	2	475	80	18.3
43*	3	.075	2	475	80	18.3 One Pump
44	3	.075	2	475	80	18.3 One Pump
45	3	Runner		300	70	18.3
46†	3	0.150	1	375	70	18.3
47	3	0.150	1	375	70	12.2
48‡	3	0.150	1	375	70	11.2

In all 3-oz. runs the booster was on until a ram pressure of 10,200 lb./in.² was reached, and in 8-oz. runs until a pressure of 3,200 lb./in.² was reached, unless otherwise noted.
*Booster on for entire run.
†Preceded by a small gate.
‡Polyethylene.

"The new Owens-Illinois line of glass pressure packages was made possible by Chem-o-sol®"

says W. M. Robertson
Drug and Chemical Industries Sales Manager
OWENS-ILLINOIS, TOLEDO, OHIO

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Table III: Experimental values obtained for 48 runs

Run No.	B *sec.*	X_f *cm.*	V_o *cm./sec.*	Θ_o *sec.*
1		18.4		
2	1.69	20.6	12.2	1.3
3		30.0		
4	ca. 0.31	7.9	ca. 25.5	ca. 1.1
5		15.1	ca. 49.0	ca. 0.9
6		20.6	ca. 66.8	ca. 0.8
7		27.8	ca. 90.4	ca. 0.7
8	0.78	9.0	11.6	1.4
9		12.1		
10	0.40	20.9	52.9	0.9
11	0.61	9.0	14.8	1.7
12	0.46	14.3	31.5	1.5
13	0.38	20.2	53.6	1.1
14	0.43	28.1	64.7	0.8
15	0.51	12.8	24.9	1.3
16	0.66	14.1	21.5	1.2
17	0.76	15.7	20.6	1.1
18	2.37	9.8	4.1	1.7
19		16.6		
20	1.98	17.0	8.6	1.3
21	1.45	24.3	16.8	1.2
26	0.57	13.9	24.4	1.6
27	0.57	12.8	22.4	1.7
28		26.4		
29	0.57	14.4	25.4	1.6
30	0.66	29.7	45.2	0.5
31		8.0	Machine control	
32		14.5	Machine control	
33		30.4		
34	0.38	23.3	61.5	5.4
36	0.67	6.0	9.1	2.4
37				
38				
39	0.48	14.8	31.1	5.8
40			Machine control	
41				
42	0.53	25.2	47.5	1.4
43	0.47	25.2	53.5	1.0
44	0.5			
45	1.8	9.9	5.5	2.5
46	1.76	10.6	6.0	1.2
47	1.76	10.7	6.0	1.5
48	4.12	23.2	5.6	0.9

tic flowed into the die cavity. This terminated the run.

Average lengths could be reproduced to better than 5%, although shot-to-shot variation within a given average could be much greater, particularly in the short RFT region where up to 30% deviations were observed.

Results

Forty-eight distance/time curves were obtained. In Table II, p. 116, operating conditions are given and Table III, above, contains the measured values of X_f. In all runs, except for 31, 32, and 40, the ram pressure had reached its maximum value before the flow entered the cavity that was under study at the time.

Figure 6, p. 120, is a photograph of the wave front looking at the bar edgewise. This shape remained fairly constant during a run and from one run to another.

Figure 7, p. 120, shows some typical curves where the distance the wave front has moved into the cavity is plotted against RFT. The run number is given on each curve in all figures.

The velocity-time curves shown in the subsequent figures were obtained directly from the raw distance-time data by dividing the change in X between two subsequent runs by the change in RFT. This average velocity over the interval is plotted against the arithmetic average of the initial and final RFT which corresponds to that particular interval.

The sample velocity time curves shown in Figs. 9 to 12 are seen to

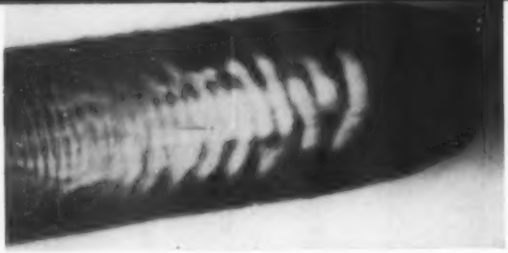


FIG. 6: Photograph of wave front. Bar thickness 0.075 in.; bar length 7.5 inches.

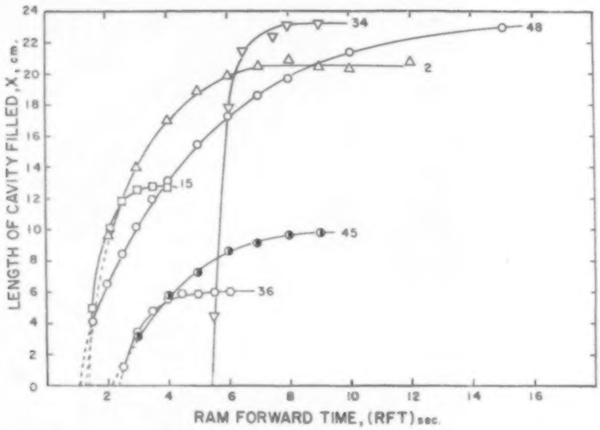


FIG. 7: Typical distance-time curves.

be extremely simple considering the highly complex operation which is taking place. All the data are correlated very well by a straight line on semi-logarithmic coordinates so the equation relating velocity and time is

$$V = V_0 \exp\left(-\frac{\theta}{B}\right) \qquad \text{Eq. 27}$$

where B is the negative reciprocal of the slope of the line or the reciprocal fractional rate of decrease of velocity, and

$$\frac{1}{B} = \frac{1}{V}\frac{dV}{d\theta} \qquad \text{Eq. 28}$$

The functional form of Eq. 27 was first observed with polystyrene in the 0.075-in. cavity which was in Position one in the die. It was found that as cylinder temperature, die temperature, and ram pressure varied the functional form was retained with different sets of values for V_0 and B. Figures 10 and 12 show some examples. The question immediately arises as to whether this equation is characteristic of the filling of a cold cavity or whether it merely described the particular system under study. When cavity thicknesses of 0.05 in. and 0.15 in. were used, the same equation was again obtained as shown in Fig. 9. Similar results were obtained when conditions for these cavities were varied.

From Fig. 3, p. 107 of Part 1, it can be seen that the cavity in which the velocity is being measured is preceded by a series of channels which, as they are part of the cooled die, are clearly not isothermal. Thus, Eq. 20, p. 111 of Part 1, shows that the velocity must depend not only upon the geometry and heat transfer in the cavity under study but also upon the geometry and heat transfer in the preceding channels in the die. Consequently, it might at first be expected that the simple form of Eq. 27 is fortuitous and depends upon the particular arrangement being used. The fact that the same results were obtained when the cavity thickness was varied, with the preceding channels held constant, indicates that this is not the case, but a much more severe test was carried out by raising the temperature to cause the flow to pass completely through the first 0.15-in. cavity and the connecting channels into the second 0.075-in. cavity (Position two). As shown in Fig. 10, the same functional form occurs. The changes in position change V_0 and B, but the exponential relationship is retained.

Actually, the result is not too surprising if a single cavity is considered as being made up of two halves. The second half may be considered to be a second cavity and here the exponential form is obtained just as in the

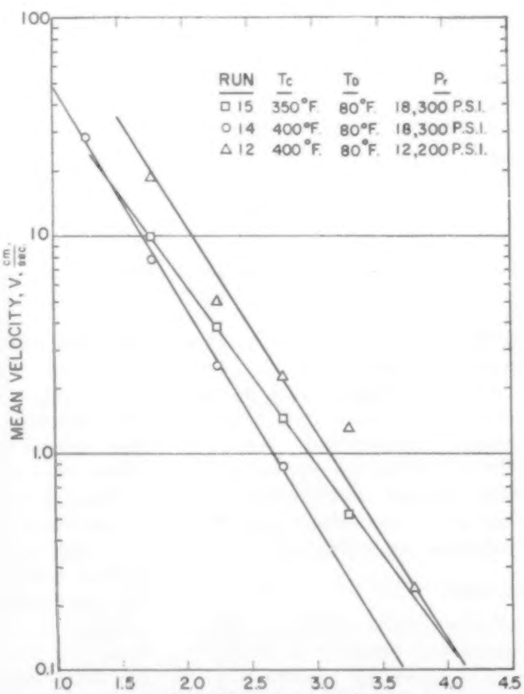


FIG. 8: Mean velocity Ram Forward Time in the 0.075-in. thick cavity, using mold Position 1 in a 3-oz. press.

first cavity although V_0 is now the velocity leaving the first half of the cavity. In this case B has the same value as in the first half of the cavity while if the second cavity were of a different cross-section, then B would change because of differences in heat transfer and velocity distribution.

At this point the evidence is very strong that the velocity-time relationship in each channel does follow Eq. 27 and the preceding channels merely shift the constants V_0 and B. Thus the velocity should also be falling in the same manner in the runners which feed the cavities and by dropping the temperature it was possible to obtain data in the first runner itself. This semicircular cross-section is preceded only by the short sprue so it is essentially the first non-isothermal cavity and, as indicated in Fig. 10, the exponential relationship holds here also.

Finally, Fig. 10 also shows that the exponential relationship holds in the cavity even if the entrance is a very narrow constriction. The data for this graph were obtained with 0.15-in. cavity in Position one connected to the runner by a 0.045-in.-long opening which had a semi-circular cross-section 0.0625 in. in diameter.

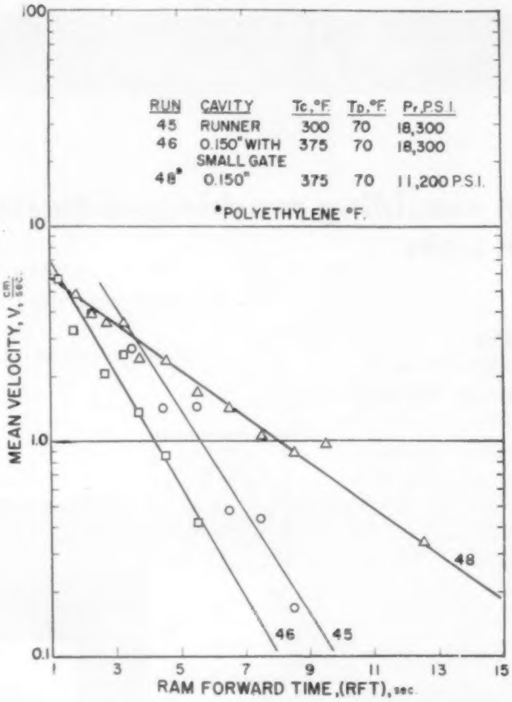


FIG. 10: Assorted velocity data on a 3-oz. press.

In the above runs the ram pressure reached the set pressure before the wave front entered the cavity under study. In this case, variation of the maximum pumping capacity or rate of build up to the set pressure may or may not affect the constants V_0 and B, depending upon the heat transfer in the channels preceding the cavity, but the exponential velocity-time equation is unchanged. The 3-oz. machine had such a rapid rate of pressure build up that the set pressure was always reached early in the flow and Eq. 27 was always obtained.

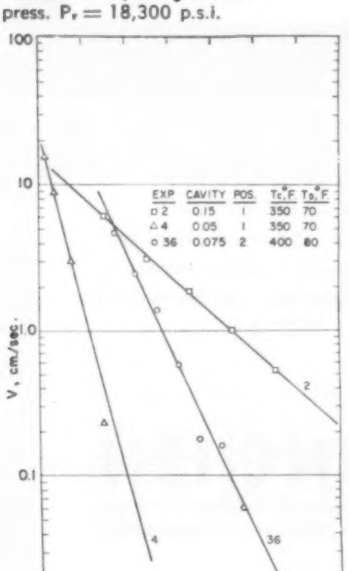
If Eq. 27 is truly general, it should hold on any machine if the set pressure is reached early enough in the flow. When the die was shifted to the 8-oz. machine, data of the type shown in Fig. 11, p. 124, were obtained. When the booster was on during a full run (Run 34) the exponential relationship always held, for the set pressure was obtained rapidly. However, when the booster was shut off early in the flow (Runs 32 and 40) the set pressure was not reached until the wave front was far into the cavity and the velocity did not fall exponentially with time but fell at a rate controlled partly by the ram characteristics, as expected.

The extreme simplicity of the velocity-time equation, even under the great complexities of the system, and the applicability over rather widely varying conditions, led to the hope that it might even hold for materials other than polystyrene. Polyethylene has rheological and thermal properties significantly different from polystyrene and a run with polyethylene which is shown in Fig. 10 confirmed this hope. Whether the relationship holds for other fluids as well remains to be seen, but it does seem likely.

It should be emphasized that these results have been obtained with cavities of constant cross-section and that it is expected that they would not be valid in the case of a cavity with a varying cross-section. Granted that Eq. 27 described the filling of a cold, empty cavity with hot polymer, under general conditions, consider the significance of the equation.

The Constant B is the time necessary for the velocity to fall to 36.8% of its value on entering the cavity. Eq. 27 indicates that the time required for the velocity to fall to zero is (To page 124)

FIG. 9: Mean velocity in various cavities and positions as a function of Ram Forward Time, using a 3-oz. press. $P_r = 18{,}300$ p.s.i.



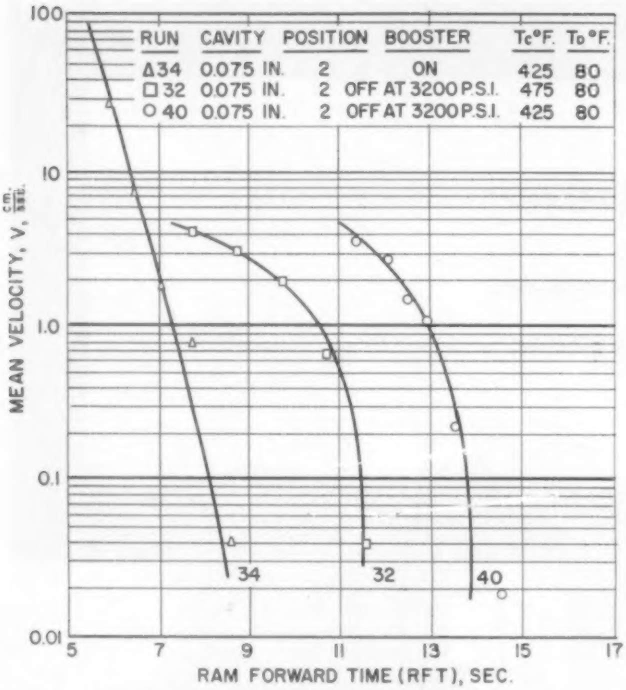


FIG. 11: Velocity data using an 8-oz. press. P_r = 14,400 p.s.i.

infinite (if the flow is not stopped by a wall). Whether the velocity does follow Eq. 27 as time approaches infinity is immaterial, all that is required is that the velocity follow Eq. 1 until it falls to a very small value. This can be checked most readily by combining Eq. 27 with Eq. 22, p. 190 of Part 1, to give the position of the wave front as a function of time of flow in the cavity,

$$X = V_0 B \left[1 - \exp\left(-\frac{\theta}{B}\right)\right] \quad \text{Eq. 29}$$

At infinite time this reduces to

$$X_f = V_0 B \quad \text{Eq. 30}$$

where X_f is the fill-out, the maximum length of flow which can be obtained under a certain set of operating conditions. (Another concept of B is now obtained for it is the time which would be required for the polymer to flow to the length X_f if there were no deceleration.) Dividing Eq. 29 by Eq. 30 yields.

$$\frac{X}{X_f} = 1 - \exp\left(-\frac{\theta}{B}\right) \quad \text{Eq. 31}$$

or

$$\theta = -B \ln\left(1 - \frac{X}{X_f}\right) \quad \text{Eq. 32}$$

And the last equation gives the time in terms of the degree of approach of the wave front to the fill-out. With the requirement that X be 99% of X_f

$$\theta' = 4.61\ B \quad \text{Eq. 33}$$

and if θ is equal to or greater than this value the measured length is at least 99% of the fill-out.

All the data have been plotted against RFT rather than time measured from the instant the wave front entered the cavity because of the difficulty of experimentally determining the zero time point. However, the data do show that this time was almost always less than 2 seconds. Thus, adding 2 sec. to θ′ gives the RFT at which the approach to the fill-out is at least 99 percent. Since B is in the range of 0.5 to 2 sec., it was quite easy to exceed this criterion on time and determine a reliable value for X_f. In a number of cases the RFT was increased so that (θ′ + 2) was exceeded by factors of 2 or 3 and no significant change in X was observed past (θ′ + 2). Consequently, it was concluded that for all practical purposes Eq. 27 gives a complete description of the flow in these simple molds. Knowing X_f and B, V_0 and the RFT at which the wave front entered the cavity could then be determined from Eq. 20 and the velocity-time curves. They are given in Table III. The values of V_0 and θ_0 so calculated were always consistent with experiment; **(To page 214)**

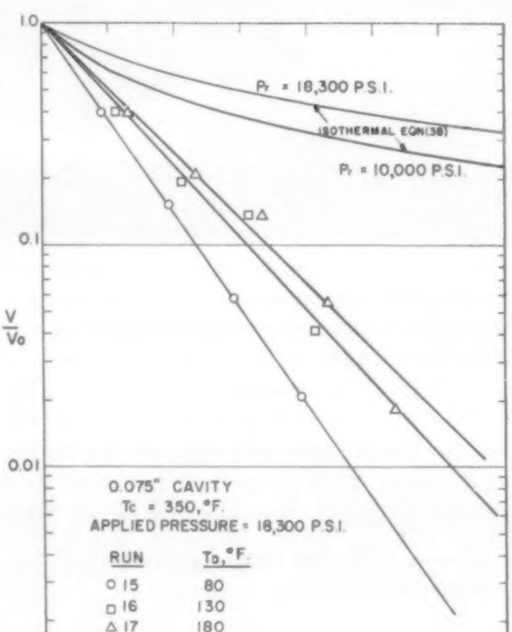


FIG. 12: Comparison of isothermal flow with experimental results. The three runs differed only in the die temperature.

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Q[1,3].	**PROVINITE® CLARITE®** (Barium-cadmium organics)	Two-part stabilizers for clears. Provinite is general purpose. Clarite for extrusions, flooring.
R.	**NALZIN® N** (Liquid zinc organic)	New co-stabilizer for barium-cadmium types. Provides sulfide stain resistance; adds heat stability.
S.	**CS-137*** (Barium-sodium organic)	Outstanding stabilizer for transparent organosols and solution coatings. Remarkable light and weather resistance.

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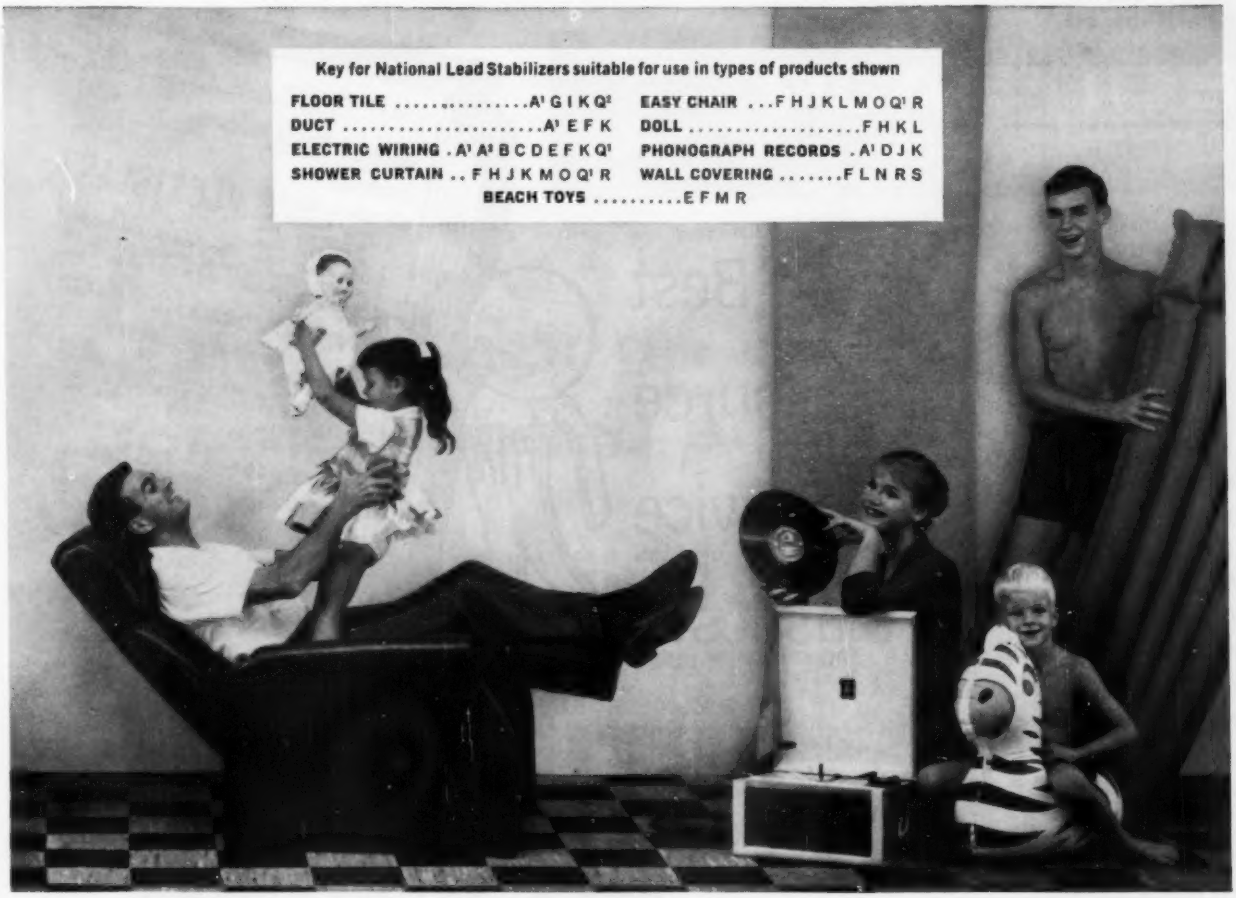

makes <u>every</u> stabilizer needed these volume vinyl products

Every one of these vinyl products is sold in volume.

Every one depends on a careful balance between desired quality and low volume cost to achieve market acceptance.

To maintain quality at the desired level, every one must be stabilized against specific heat or light effects which may damage the stock during production or in service.

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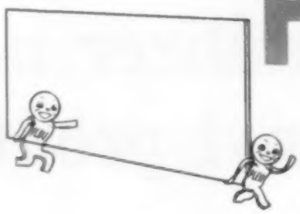

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Plastic glazing for high-speed aircraft

The solution to glazing problems of current and future air and spacecraft lies in the use of composite transparency structures. This article discusses available materials and suggested designs

By Carey Carpenter†

Historically, monolithic and laminated transparent plastics have given excellent service as aircraft glazing at temperatures encountered at speeds under Mach 2. Basic product improvement, coupled with development of stretching techniques, has led to availability and widespread use of plastic glazing suitable for withstanding pressurization loads and bullet impact without progressive fracture, and possessing adequate solvent-craze resistance. Such materials have been generally limited to approximately 220° F. steady-state temperature.

Aircraft and spacecraft design feasibility have progressed sufficiently to require glazing for steady-state temperatures of 350° F. and transient temperatures up to 1000° F. Available metals and fabrication techniques permit the design of piloted aircraft capable of operation at skin temperatures approaching 1000° F. Such designs are generally limited because of restrictions imposed by supporting materials, such as transparencies, sealants, and edge attachments.

As temperatures go up and up, the question arises—why not use glass instead of plastic? There are three primary reasons why plastic is to be preferred over glass: 1) weight saving, 2) superior toughness properties, and 3) ease of forming with good optics.

Composite structures

A satisfactory solution to glazing problems of current and future designs lies in the use of a composite transparency structure. In its simplest form, this will consist of an inner structural face and an outer heat shield. This composite may be a laminate, or it may be air-gap glazing with an actual separation between inner and outer faces. In the moderate temperature range of 300 to 450° F., the outer heat shield may be a non-structural heat-resisting plastic material with an inner structural member of laminated or monolithic plastic operating within a range that permits it to maintain its structural integrity.

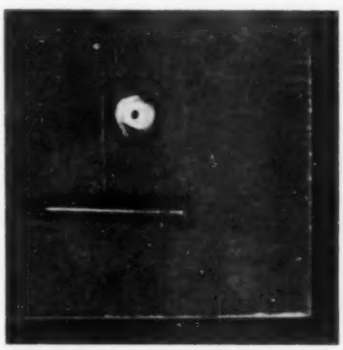

FIG. 1: Nail hole in stretched Plexiglas 55 shows material's shatter resistance.

Above 450° F. it appears that another step is necessary to provide heat resistance with good optics and structural reliability. For these higher temperatures, it appears quite feasible to design air-gap glazing with glass as an outer free floating non-structural heat shield, and laminated or monolithic plastic as the inner member. The high-temperature transparency structure will be made up of several parts, being a complex double or triple glazing with outer heat shields, inner structural members, and suitable edging and sealing. This complex structure might well incorporate reflective coatings on the inner glass surface to reduce infra-red radiation to the plastic material and electrically conductive coatings for defogging purposes.

Where very high external temperatures are expected, the transparency structure may require the circulation of a cooling fluid such as air, carbon dioxide, or perhaps a liquid within the space between

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†Technical Manager, Swedlow, Inc., Los Angeles Div.

Condensed from a paper presented at 1959 Pacific Coast Section SPI Conference.

the glass and plastic members. The design of both simple and complex structures will consider heat gradient as a basic design criteria. The selection of materials and configurations must be such that a soak of the outer transparency members at highest aerodynamic heating level to be expected from the design flight profile does not bring inner members above safe operating temperatures.

There are many possible variations to this type of construction which may be used to meet the design requirements of particular applications. The double-glazed concept permits industry to combine the properties of both glass and plastic into a composite design for maximum structural efficiency and lowest weight. This design will permit the later incorporation of such additional requirements as cooling air between glass and plastic, and defogging through deposition of a transparent electrically conductive coating on the inner plastic member without the expense and time lag of a major design change. The use of a tough stretched structural plastic for the load-bearing member of this composite structure will lessen the possibility of explosive decompression which is always present with an all glass or unstretched monolithic plastic structure over a pressurized enclosure.

Plastics for glazing

Plastics available or under development that offer promise for use in high-speed aircraft glazing will be briefly described.

Plexiglas[1] 55 is a partially cross-linked methyl methacrylate material. Stretched Plexiglas 55, meeting the requirements of MIL-P-8184, exhibits superior toughness and craze resistance properties. In fact, the quality control of stretched sheeting centers around a fracture propagation test. This test measures the load necessary to develop a fast break in a sample cross-section of known area, and with a known initial fracture. The results of this test are converted to a number called "K-factor," which has become a standard toughness comparison for the industry. Stretched Plexiglas 55 has a minimum K-factor of 2500, as opposed to 900 for the as-cast material. Figure 1, p. 129, shows a piece of stretched Plexiglas 55 which has had a nail driven through it to illustrate its shatter resistance. The small crater illustrates the laminar nature of the material after stretching. Glass or unstretched acrylic or polyester would have shattered into many pieces. Stretched Plexiglas 55 parts are being furnished for many of today's production aircraft (See Fig. 2, above).

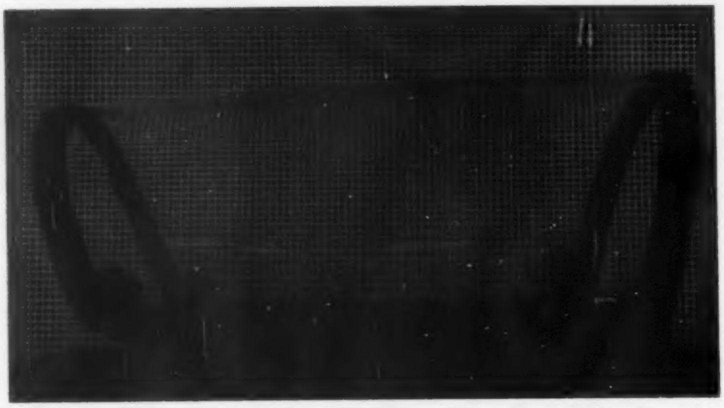

FIG. 2: Stretched Plexiglas 55 parts are being used in many of today's aircraft. Republic F-105 canopy is shown in front of grid board.

Sierracin[2] *RC-500* is an acrylic material which was developed to meet the requirements of MIL-P-8184 and is in limited production. It can be stretched with marked improvement in toughness.

Sierracin 880 is a cast, polyester-base thermosetting material which has a heat distortion temperature of about 280° F. It is furnished to the fabricator as a partially cured or "B" stage sheet stock which may be formed and subsequently postcured by application of temperatures higher than those used for forming. Like other highly crosslinked materials, it is notch sensitive, and is more attractive from a structural standpoint when used as one or both faces of a laminated structure.

Sierracin 890 is a material under development similar to Sierracin 880, but with a heat distortion temperature around 325° F.

Selectron[3] *400* is a thermosetting acrylic cast sheeting which is under development. It will be supplied to the fabricator as a "B" stage sheet which can be formed and subsequently cured by heat or irradiation. The present heat distortion temperature is about 390° F., indicating that the material has excellent potential for heat shield applications. Studies are in progress to determine whether stretching in the "B" stage will reduce the notch sensitivity of this material.

Lexan[4] is a polycarbonate being evaluated as a possible transparency material in the 275 to 325° F. range. It is a very tough material, and is attractive from toughness and temperature resistance standpoints. It compares well with MIL-P-8184 requirements, except for slightly lower modulus values. However, it is difficult to fabricate into optically acceptable sheets, and it is susceptible to crazing by certain solvents.

Special materials and processes available

Other materials and processes available or under development for glazing high speed aircraft need to be considered.

Glass-faced acrylic: We have pioneered adhesive studies and fabrication techniques which permit thin sheet glass to be bonded to stretched acrylic sheet. This development has been limited to flat sheets and small sections so far, but current work with mildly contoured sections looks promising. The obvious advantage of this construction is the abrasion resistance of glass combined with the shatter resistance of stretched acrylic. This promises weight sav-

[1]Tradename of Rohm & Haas Co.

[2]Tradename of Sierracin Corp.

[3]Tradename of Pittsburgh Plate Glass Co.

[4]Tradename of General Electric Co.

ings and added safety in windshield design, and will show an economical advantage in lower replacement costs for commercial aircraft windows.

Sheet interlayer material: Most of the laminated transparencies today are joined with an interlayer of polyvinyl butyral (PVB). It is characterized by good adhesion, good sunlight stability, poor low temperature (−65° F.) flexibility, and a maximum service temperature limitation of about 220° F. Stretched Plexiglas 55 can be laminated with PVB and subsequently formed, without loss in the K-factor or destroying the bond between the sheets and the PVB. For higher temperatures, "Type K" silicone interlayer[5] has been used up to 300° F. "Type M" material[5], while still experimental, shows promise of being usable at 450° F. One disadvantage of the present silicone interlayers is the high temperature cure which is not compatible with certain critical temperatures for existing transparency sheets. For example, stretched Plexiglas 55 relaxes at a temperature less than the curing temperature of "Type K," and subsequent forming of the laminate is impossible.

[5]Product of Dow Corning Corp.

Cast-in-place interlayer: Progress is being made on the development of a liquid interlayer material which may be cast between formed and cured sheets of high temperature plastic, and subsequently cured in place. Target properties for this material include low temperature flexibility, water white color, sunlight stability, good adhesion, cure cycle adaptable to production, and suitable high temperature properties. We believe cast-in-place interlayers now being developed will function satisfactorily to 450° F.

Special glass materials: Temperatures from 450° F. upward will require glass heat shields to provide a temperature gradient compatible with the working temperatures of the plastic inner structures. In most cases, an air gap will separate the glass from the plastic. The alumino-silicate, the borosilicate, 96% silica, and fused silica glasses will be able to withstand the working temperatures and thermal shock encountered in this service. Both Corning Glass Works and Pittsburgh Plate Glass Co. are active in this field. From the viewpoint of a fabricator, one of the necessary developments by the glass companies is the ability to produce large contoured sheets of optical quality from the special glasses for use as the outer member of a double-glazed, compound-curved, composite transparent enclosure.

Electrical anti-fog: In the field of coatings for transparencies, the Sierracin Corp. has developed an electrically conductive, transparent coating which has been used to heat aircraft windshields and canopies for the removal or prevention of fog and ice. In a typical operation, the stretched acrylic sheet is coated and then laminated to another stretched acrylic sheet with PVB, with the conductive coating inside the sandwich for protection, and bus bars installed. The flat laminate is then formed and fabricated into a finished part. More than 300 sets of laminated anti-fog panels of stretched Plexiglas 55 have been processed for the Convair F-106A and F-106B airplanes. Prototypes of other configurations such as the AVRO CF-105 have been fabricated, and glass windshields for commercial aircraft use with electrical anti-fog coatings are regularly produced. This type of coating has been used to reduce thermal radiation.

Edge attachments: Edge attachments in current use for plastic glazings have usually been reinforced plastic laminates, made with synthetic fibers such as Orlon[6] or nylon and laminated with acrylic or epoxy resins. The edging is usually tailored to each individual transparency design. As aircraft glazing meets higher and higher temperatures, outer edge attachments will be made of metals which not only are able to withstand higher skin temperatures, but which have lower coefficients of thermal expansion to match those of the outer glass heat shields. Such metals as Kovar, a nickel-cobalt-iron-manganese alloy, may be suitable. The design of edging for high **(To page 220)**

[6]Tradename of E. I. du Pont de Nemours & Co., Inc.

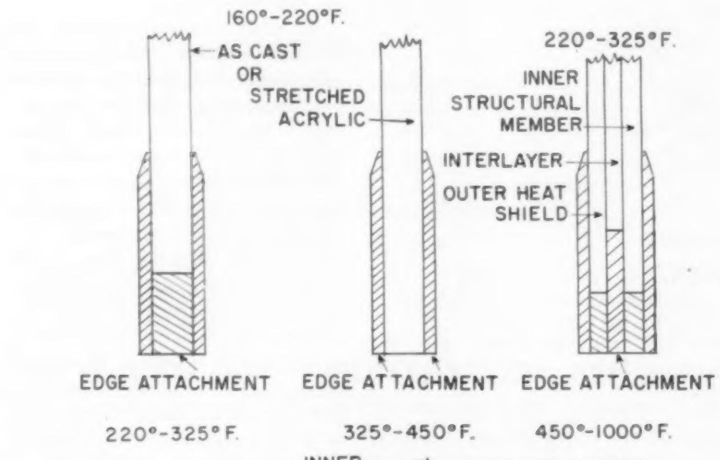

FIG. 3: Design configurations for aircraft glazing.

Ethylene-butene copolymer resins

By J. E. Pritchard*, R. M. McGlamery*, and P. J. Boeke†

New ethylene-butene copolymer resins now available combine high stiffness and toughness, excellent stress-cracking resistance, and superior performance under long-term loads. These new copolymers first offered commercially in September 1958 are opening up major markets in such applications as detergent bottles, fibers, wire and cable coatings, and injection molding. Designated as 5000 Series resins, the new polymers have a nominal density of 0.95 compared with 0.96 for the original Marlex[1] resins. The lower density is obtained by copolymerization of ethylene with 1-butene to yield polyolefins containing short chain branches. The original 0.96-density polymer (6000 Series) is recommended where maximum rigidity and maximum resistance to permeation are required.

General physical properties

Typical physical properties of the various melt index types in the copolymer series are compared with those of the 0.96-density polyethylenes in Table I, p. 134. It is evident from these data that the copolymer resins are distinguished from the higher density resins by exceptional resistance to environmental stress-cracking. They also show a somewhat higher elongation but have slightly lower tensile strength and stiffness. A high melting point imparts shape retention at 250° F., which still permits standard hospital sterilization (15 p.s.i. steam pressure for 20 minutes). As to physical appearance, freedom from color, odor, and stability toward heat and light, the copolymer resins are similar to the polyethylenes.

Any discussion of general physical properties must include information on the impact strength. Because the values obtained are dependent to a marked degree upon the method of testing, it has been necessary to study this property in some detail. As indicated in Table II, p. 134, the 0.95-density polymers yield impact values by the Izod test that are below those of 0.96-density polymer of comparable melt index. A partial explanation for this is that the melt index does not have the same significance for different polymers. This is evident from a study of flow rates on a high-shear instrument (1)[2]. At high shear rates the flow of the higher melt index types of the new polymers may be as much as 40% higher than would be anticipated from the melt index. When comparisons are made on the basis of high-shear flow, the Izod and tensile impact (2) strengths are reasonably close to that of the higher density polymers. Another test which is used extensively in many laboratories is the falling-ball impact test. The falling-ball data presented in Table II were obtained by dropping a 2.4-lb. steel ball on the gate area of a sprue-gated injection molded bowl. The data indicate that items molded are extremely tough.

As with all thermoplastics, the physical properties of the copolymer resins are sensitive to changes in temperature and rate of testing. Three-dimensional plots showing the effects of strain rate and temperature on the tensile stress and elongation at yield of a 0.3-melt-index 0.95-density copolymer are shown in Figs. 1 and 2, left. The tensile stress at yield shows a general increase with increasing strain rate. The rate of strain has less effect at higher temperatures. The elongation at yield shows the same dependence on temperature and strain rate. At a standard testing rate of 2 in./min. the tensile stress at yield varies from 4800 to 900 p.s.i. and the elongation at yield varies from 9 to 40% over the temperature range of from 0° to 200° F.

The useful tensile stress of plastics for many applications must be limited to the stress at low elongations. The stress at 1% elongation is shown in Fig. 3, p. 135, for 0.3-melt-index 0.95-density copolymer. The values on

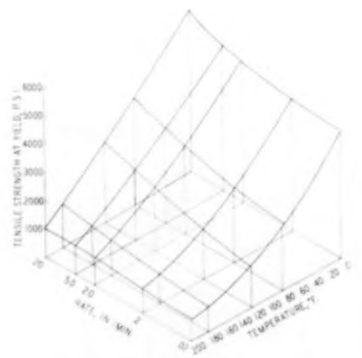

FIG. 1: Effect of temperature and rate of loading on tensile stress at yield for 0.3-M.I. 0.95-density copolymer.

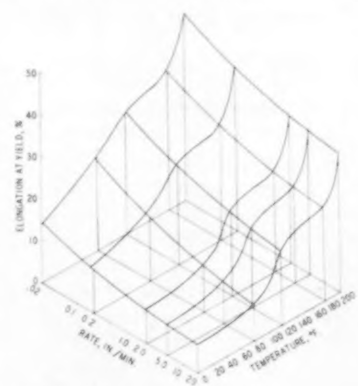

FIG. 2: Effect of temperature and rate of loading on elongation at yield for 0.3-M.I. 0.95-density copolymer.

*Research Div., Phillips Petroleum Co.
†Plastics Sales Div., Phillips Chemical Co.
[1]A trademark for Phillips' family of olefin polymers.

[2]Numbers in parentheses link to references at end of article, p. 224.

this graph were taken from stress-strain curves over a range of testing temperature and strain rate. At the lowest strain rate, 0.05 in./min., the value varies from 50 p.s.i. at a temperature of 250° F. to 1250 p.s.i. at 32° F.

Another property that is dependent on test temperature and rate of testing is stiffness. Stiffness in flexure (ASTM D 747-50) for a cantilever beam is 115,000 p.s.i. for the copolymer resin. This value is 75% of the stiffness of the 0.96-density resins. The flexural modulus (ASTM D 790-49T) for a center-loaded beam is approximately 50% higher than the stiffness value. Table III, p. 135, shows that the flexural modulus of the 0.95-density series is approximately 75% of the values for the 0.96-density series over the temperature range of 75° to 150° F.

Stress-cracking

The stress-cracking phenomenon exhibited by most polyethylenes has been studied by many investigators (3-6). Two distinct types have been reported. Cracking exhibited by polyaxially stressed polyethylene in the presence of a surface-active environment is generally termed environmental stress-cracking. Thermal stress-cracking, or thermal embrittlement as it is sometimes called (7), is exhibited by some polyethylenes held in a stressed condition at elevated temperatures for a period of time. Although the causes of stress-cracking are not fully understood, it is usually an accepted fact that molecular weight, density, and molecular weight distribution have an important bearing on the susceptibility to stress-cracking. Probably the most significant difference between the copolymer resins and the 0.96-density resins is a very marked increase in resistance to both environmental and thermal stress-cracking. This is achieved through an optimum balance of density and molecular weight.

Environmental stress-cracking: The superiority of the copolymer resins at various melt index levels based on the Bell Laboratory test in Igepal at 50° C. is shown in Table I. Table IV, p. 135, compares the F_{50} values of the 0.3-melt-index copolymer resin with a 0.2-melt-index homopolymer in a number of severe stress-cracking environments. This table shows a 5- to 10-fold improvement for the copolymer resin.

Thermal stress cracking: Table V, p. 135, shows the failure time for the 0.95- and 0.96-density resins under 5 to 40% strain at 160° F. These data were determined by bending strips around mandrels of varying radii to impose known strain on the outer surface and noting the time for cracking to develop. With the copolymer resin, the critical strain is increased to over 40 percent.

Two of the very important applications where stress-cracking resistance is critical and necessary for successful industry acceptance are the liquid detergent bottles

Table I: Physical properties of polyethylene and ethylene-butene copolymers

	0.95-density copolymers				0.96-density polyethylenes			
Melt index (ASTM D 1238-57T)	0.3	1.2	4.0	6.5	0.2	0.9	3.5	5.0
Tensile strength (ASTM D 638-58T), p.s.i.	3,600	3,600	3,600	3,600	4,400	4,400	4,400	4,400
Elongation (ASTM D 638-58T), %	70	40	30	20	30	25	15	12
Stiffness (ASTM D 747-58T), p.s.i.	115,000	115,000	115,000	115,000	150,000	150,000	150,000	150,000
Vicat softening temperature (ASTM D 1525-58T), ° F	255	255	255	255	260	260	260	260
Hardness, Shore D	67	67	67	67	68	68	68	68
Environmental stress cracking, F_{50}, hr.	400	70	20	10	60	14	2	1
Brittleness temperature (ASTM D 746-57T), ° F.	<—180	<—180	—160	—140	<—180	<—180	—150	—100
Shape retention at sterilization temperature (250° F.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table II: Impact properties of polyethylenes and ethylene-butene copolymers

	0.95-density copolymers				0.96-density polyethylenes			
Melt index	0.3	1.2	4.0	6.5	0.2	0.9	3.5	5.0
CIL flow index[a]	1.8	7.0	17	24	1.2	3.4	10.0	12.5
Izod impact strength, ft.-lb./in. of notch	4	1	0.8	0.7	14	4	1.5	1.2
Tensile impact strength, ft.-lb./in.^{2}	81	47	37	31	100	64	41	30
Falling ball, in.	>96	>96	24	6	>96	>96	36	12

[a]Grams/10 min. through a 19-mil orifice at 1500 p.s.i. and 190° C. (Canadian Industries Ltd. test, Ref. 1)

and wire and cable coatings. The detergent bottle application requires a high resistance to the surface-active components found in liquid household detergents. Wire and cable applications require a complete absence of failure due to thermal stress-cracking.

Applications

Detergent bottles: The new stress-cracking-resistant copolymer is ideally suited for this use. Blow molded into an economical, thin walled, unbreakable container, the 0.3-melt-index resin permits the successful packaging of liquid household detergents.

A study of the transportation and warehousing involved in marketing this product clearly indicates a wide range of service conditions may be expected. Warehouse temperatures of 125° F. may be found during the summer in many of our southern states, and sub-zero temperatures may be encountered in the winters of our northern states. The ideal detergent bottle resin must retain good stress-crack resistance at high temperatures and have excellent toughness and impact resistance at low temperatures.

Table VI, p. 138, shows the excellent stress-crack resistance of the copolymer resin in commercial-type detergent bottles subjected to accelerated aging and long-term shelf-life tests. These data reflect the added severity of testing with a partially filled bottle and indicate also the role of bottle geometry in affecting failure time under the most vigorous accelerated conditions. Many bottles had decorative features which impose severe stress concentrations.

The excellent **(To page 138)**

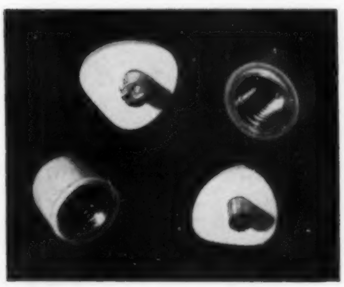

FIG. 4: Brass inserts molded in 0.95-density ethylene-butene copolymer; aged at 250° F. for 1000 hours.

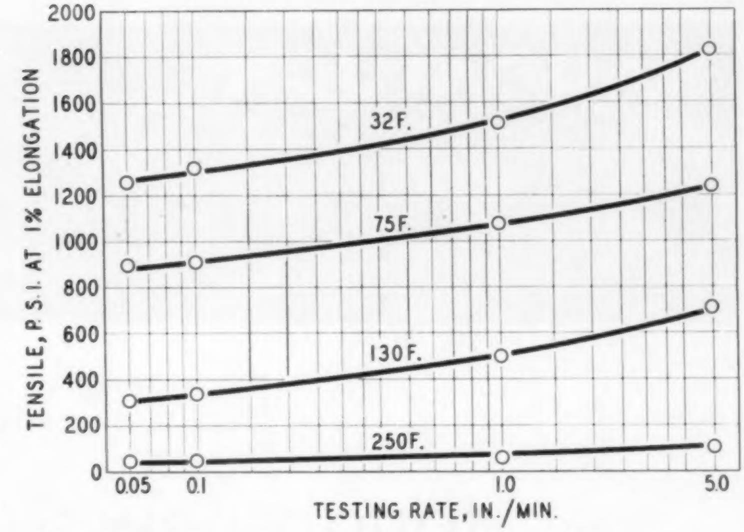

FIG. 3: Effect of temperature and rate of loading on tensile stress at 1% elongation for 0.3-melt-index 0.95-density copolymer.

Table III: Effect of temperature on flexural modulus of polyethylene and ethylene-butene copolymer

	Flexural modulus	
Temperature	*0.3-M.I. 0.95-density copolymer*	*0.2-M.I. 0.96-density polyethylene*
° F.	p.s.i.	p.s.i.
75	165,000	220,000
100	120,000	165,000
125	85,000	120,000
150	60,000	85,000

Table IV: Stress-cracking resistance (F_{50}, Bell test) at 50° C. of polyethylene and ethylene-butene copolymer

Environment	*0.3-M.I. 0.95-density copolymer*	*0.2-M.I. 0.96-density polyethylene*
	hr.	*hr.*
Igepal CO-630	300—400	60
Silicone DC-200	>1000	43
Ethyl alcohol (USP, 100%)	>1000	20
Acetic acid (glacial, reagent grade)	>1000	9
Sodium hydroxide solution (5%, reagent grade)	670	34
Ethylene glycol (technical grade)	>1000	40
Methyl ethyl ketone (reagent grade)	>1000	34
Diisooctyl sebacate (technical grade)	>1000	36
Ivory soap solution (5%)	350	20

Table V: 160° F. thermal stress-cracking time of polyethylene and ethylene-butene copolymer

Strain	*0.3-M.I. 0.95-density copolymer*	*0.2-M.I. 0.96-density polyethylene*
%	*hr.*	*hr.*
40	>1000	<1
30	>1000	<1
20	>1000	1
10	>1000	7
5	>1000	>1000

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impact resistance of the 0.3-melt-index copolymer is illustrated in Table VII, below, in the bottle drop tests that were conducted at various temperatures.

Wire and cable coating: The 0.3-melt-index copolymer offers a desirable balance of properties for the wire and cable industry. Complete absence of thermal stress-cracking has been substantiated in use tests on the natural and black compounded resin (Table VIII, p. 140). These tests show that even with high strains imposed by twisting the wire on its own diameter, no cracks develop after 2500 hr. in air up to temperatures as high as 250° F. Under a more severe test in which the twisted wire is exposed to a detergent at a temperature of 195° F., the resin resists cracking for 1000 or more hours.

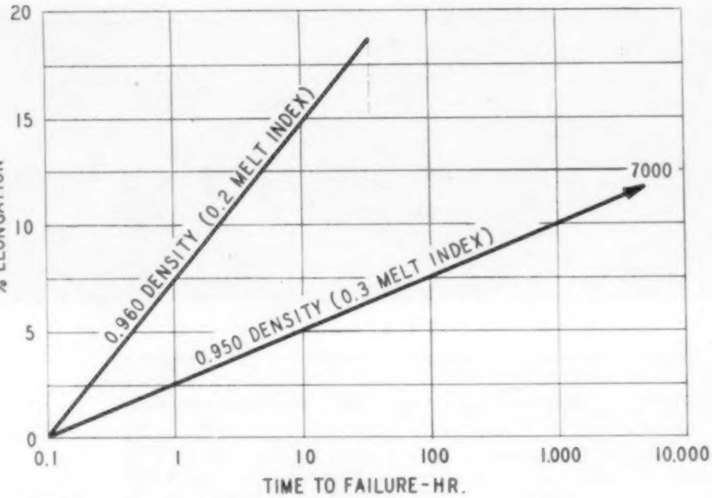

FIG. 5: Creep rate at 20,000 p.s.i. load of filaments of 0.96-density polyethylene and 0.95-density ethylene-butene copolymer.

In abrasion and temperature resistance, chemical inertness, and general electrical properties, the new copolymer is similar to the 0.96-density polyethylene. Some of the pertinent electrical and other physical properties are shown in Table IX, p. 140, for natural as well as for black compounded copolymers.

Film: As with the 0.96-density resins, thin films of excellent clarity and sparkle can be extruded from the new 0.95-density olefin resins. The technique for producing such clear films involves a quick quench by slot extrusion into water at approximately 145° F. The high flow types (high melt index) in both series are required for best clarity and gloss. The die lips must be positioned within 0.25 in. of the water bath to facilitate rapid quenching of the polymer (8). As indicated in Table X, p. 140, the film from 0.95-density copolymer exhibits slightly higher permeability to water vapor and gases than film from 0.96-density polyethylene, but still retains sufficient heat resistance to withstand hospital sterilization. It has excellent clarity, less stiffness, and a somewhat softer "feel" than film from the 0.96-density polymer. Applications for the two films may differ primarily as a result of the difference in stiffness and crisp-

Table VI: Tests of ethylene-butene copolymer (0.3-M.I. 0.95-density) detergent bottles 10% filled with Joy

Bottle	*Bottle size*	*Wall thickness*	*125° F., 32-day test*	*140° F., 10-day accelerated test*	*150° F., 10-day accelerated test*
	oz.	*mils*			
A	4	20	No failure	No failure	No failure
B	12	32	No failure	No failure	No failure
C	12	32	No failure	No failure	Failed, 8 days
D	22	35	No failure	No failure	Failed, 8 days
E	22	26	No failure	No failure	No failure
F	32	30	No failure	No failure	Failed, 5 days
G	32	30	No failure	No failure	No failure

Table VII: Effect of temperature on drop-impact tests of water-filled bottles[a] blow-molded of ethylene-butene copolymer (0.3-M.I. 0.95 density)

Bottle	*Bottle size*	*Wall thickness*	*6-ft. drop, 80° F.*	*6-ft. drop, 40° F.*	*6-ft. drop, 0° F.*
	oz.	*mils*			
A	4	20	Passed	Passed	Passed
C	12	32	Passed	Passed	Passed
D	22	26	Passed	Passed	Passed
F	32	30	Passed	Passed	Passed

[a]Bottles filled with water and conditioned at test temperature for 3 hours.

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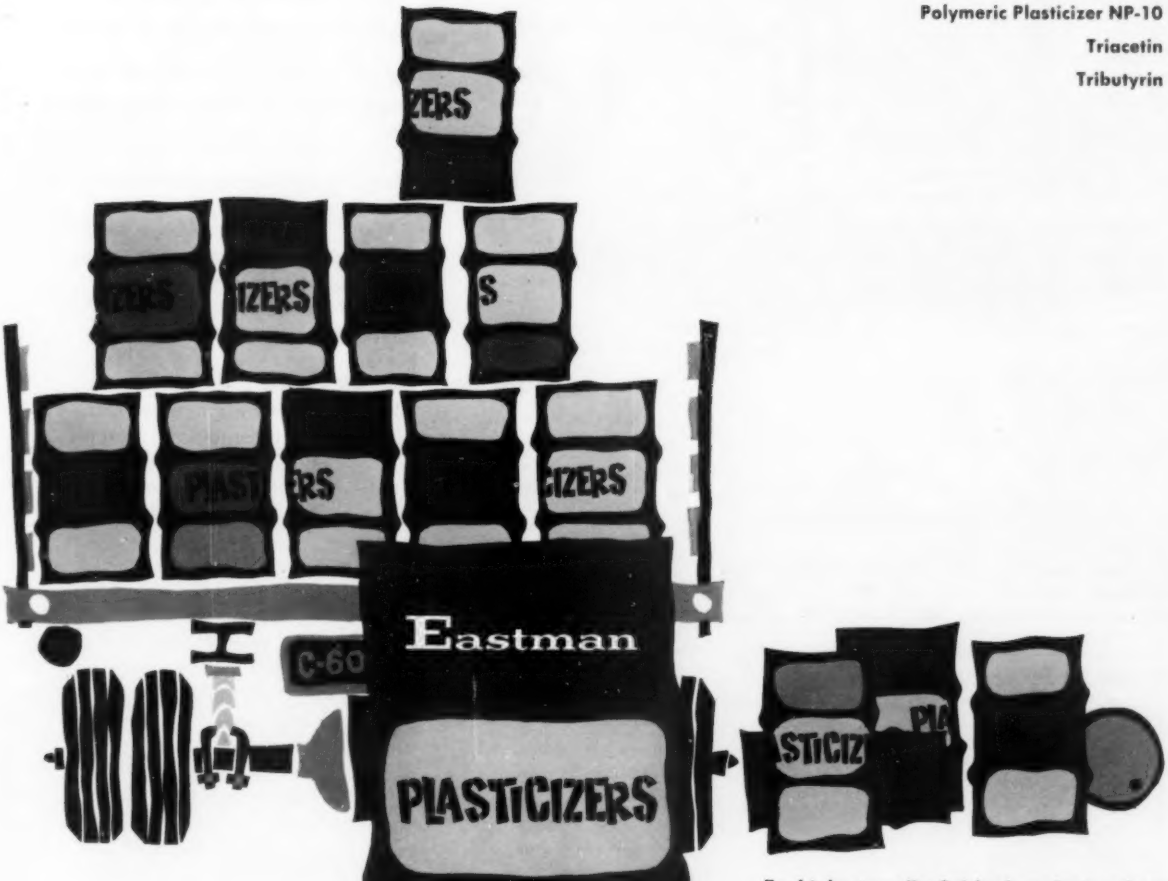

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ness, with the 0.96-density probably best suited for overwrap applications where maximum resistance to permeability is required and the 0.95-density film preferred for soft goods and bakery packaging. Both types of film are suitable where high clarity and extended shelf life are desired.

The film made from both resins prints with standard polyethylene inks after the usual surface treatment. Due to the low extensibility of these films, excellent registration is obtained. Both types of film can be easily heat sealed on equipment now commonly used with conventional polyethylenes.

Injection molding: Lower density rigid polyolefins are of interest as injection molding resins because they offer high flow response at the pressures encountered in normal molding operations. In flow tests carried out in a laboratory spiral flow mold in a conventional injection machine under normal operating conditions, the 0.95-density copolymer exhibits as much as 15% greater flow than a 0.96-density polyethylene of comparable melt index. The reason for the increased flow characteristics of the 0.95-density polyolefins is due, at least in part, to a somewhat wider molecular weight distribution.

The greater flow response produces an excellent surface gloss at a lower melt index than other polyethylenes. In many instances this makes it possible to carry out molding operations at a lower cylinder temperature. This, of course, is directly translatable into decreased molding cycles.

Many industrial moldings have used conditions that require the higher level of stress-cracking resistance that can be obtained with the copolymer resins. Another important area is the use of molded-in metal inserts. It has been found that the 0.95-density resins with proper molding conditions permit the use of inserts that were not possible with the 0.96-density resins. This advantage again reflects the improved resistance to stress-cracking inherent with these resins and is believed to be related to the somewhat smaller crystallite size which forms in the 0.95-density resins on cooling from the molten state. The comparison of the crystallite size of the two series of resins shows a reduction of approximately 30% (9). Figure 4, p. 135, shows typical molded-in brass inserts ¼-in. in diameter which produced no cracks or fissures after accelerated aging at 250° F. for 1000 hours.

Another factor of importance is a decreased tendency to warp with the lower density polymer. Laboratory molding studies using a flat, unribbed casting area disk (0.035 by 7.75 in.) reveal that proper choice of molding conditions will produce warp-free specimens from 0.95-density rigid polymer. Recognizing this as a severe test, the performance of the new rigid (To page 224)

Table VIII: Stress-cracking resistance of wire coated with 0.3-melt-index 0.95-density ethylene-butene copolymer

	Natural copolymer	*Black compound*
	hr. to failure	*hr. to failure*
Coated No. 14 copper wire, twisted on own diameter, heated in air oven at 212° F.	>2500	>2500
Coated No. 14 copper wire, twisted on own diameter, heated in air oven at 250° F.	>2500	>2500
Coated No. 22 copper wire, twisted on own diameter, immersed in 50% Igepal solution, heated in air oven at 195° F.	>1000	>1000

Table IX: Electrical and physical characteristics of 0.3-melt-index 0.95-density ethylene-butene copolymer

	Natural copolymer	*Black compound*
Dielectric constant		
At 1 kilocycle	2.35	2.64
At 1 megacycle	2.35	2.62
Dissipation factor		
At 1 kilocycle	0.0002	0.002
At 1 megacycle	0.0003	0.004
Dielectric strength, ⅛-in. thickness, v./mil	500	475
Volume resistivity, ohm-cm.	6×10^{15}	—
Abrasion resistance (Armstrong), cc./100 cycles	0.24	0.24
Hardness, Shore D	67	67

Table X: Properties of water-quenched rigid polyethylene and ethylene-butene copolymer films, both 0.7 mils thick

	0.96-density polyethylene	*0.95-density copolymer*
Melt index	5.0	6.5
Tensile strength		
Machine dir., p.s.i.	9000	8000
Transverse dir., p.s.i.	4000	3000
Elongation		
Machine dir., %	200	200
Transverse dir., %	25	25
Elmendorf tear		
Machine dir., g./mil	20	25
Transverse dir., g./mil	Does not tear	Does not tear
MVT, g./mil/100 in.^{2}/24 hr.	0.44	0.58
Gas permeability $\times 10^9$		
Oxygen, cc. × cm./sec. × cm.^{2} × cm. Hg.	0.13	0.16
Carbon dioxide, cc. × cm./sec. × cm.^{2} × cm. Hg.	0.48	0.72
Haze, %	5	5
See through,[a] ft.	Unlimited	Unlimited
Sterilizability (250° F., 20 min.)	Yes	Yes

[a]Comparative visibility of eye chart viewed with film held approximately 4 in. from the eyes and without film.

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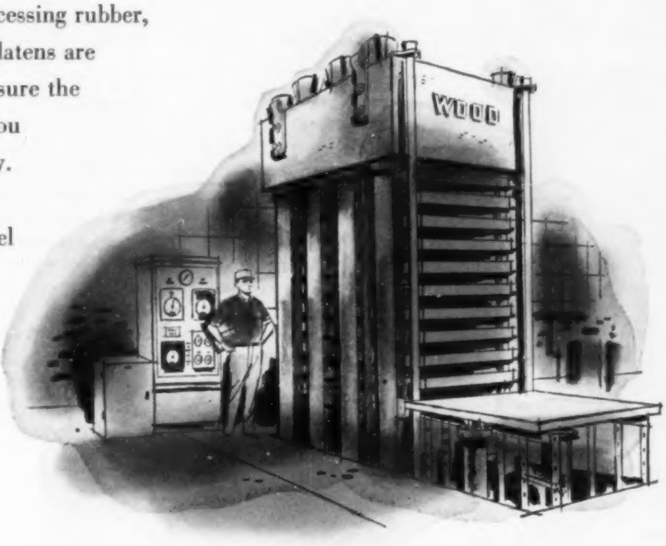

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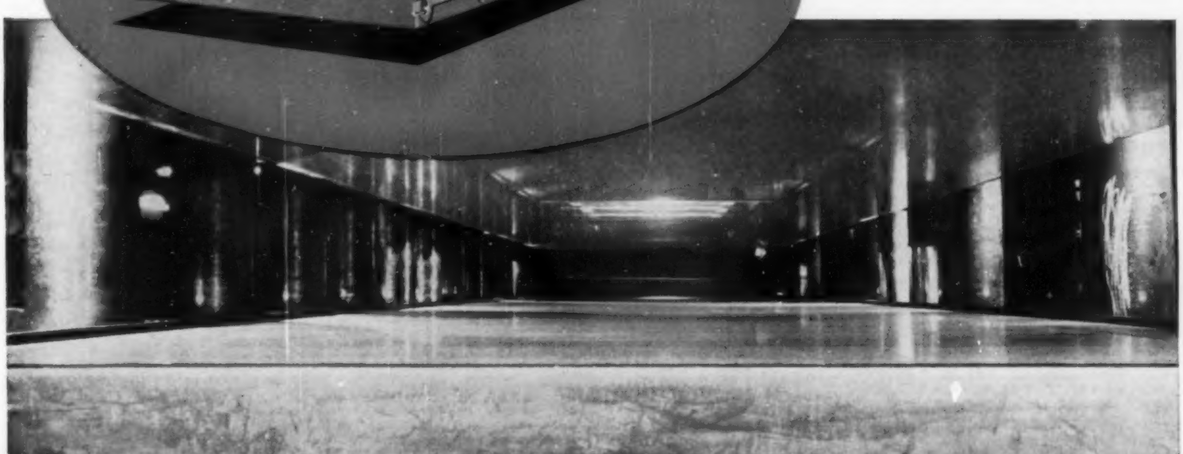

Epoxidized polyolefin resins

By Frank P. Greenspan,* Chris Johnston,** and Murray Reich**

A20 epoxy resins are epoxidized polyolefins which can be cured at room temperature with dibasic acid and anhydride curing agents. High flexural strengths and heat distortion temperatures, and superior age resistance are exhibited by the resin when cured with maleic anhydride and aliphatic polyols. Polyamine formulations exhibit exceptionally long pot life and are capable of curing readily at elevated temperatures. The cured resins show thermal aging resistance superior to the glycidyl ether resins. A20 resins may similarly be cured with other polyfunctional active hydrogen compounds, e.g., polyphenols and polymercaptans. The presence of reactive double bonds provide further sites for graft polymerizing with a vinyl monomer. Hard, tough protective coatings with good adhesion and chemical resistance can be prepared 1) by baking the resins alone or with phenol-formaldehyde and nitrogen resins, 2) by crosslinking with polyamines, acids, or anhydride systems, and 3) by conversion to a resin ester. It is expected that these resins will open up new applications of epoxy resins in castings, laminates, adhesives, and coatings.

The epoxy resins of commerce are condensation products of polyhydric phenols (e.g., bisphenol) and epichlorohydrin, with epoxy groups present in the form of terminal glycidyl ether structures (1-4).[1] In recent years, increasing attention has been given to the resin potential of diepoxides and polyepoxides other than glycidyl ethers. A number of such materials have been described based upon vinyl cyclohexene dioxide (5), dicyclopentadiene dioxide (6,7), epoxidized polybutadiene (8,9,10), and structures containing cyclohexene oxide rings (11).

A new family of epoxy resins has been developed in our laboratories, a product of extensive research in the epoxy chemical field carried out over many years. These may be classified as epoxidized polyolefins and have in part been described in the patent literature (13-16). It is the purpose of this paper to discuss these resins more fully, with particular regard to the curing characteristics and mechanical properties of a representative member of the series, code designated A20-75 resin.

Chemistry and properties

The structure of A20-75 resin is schematically depicted in Fig. 1, below. Typical properties are presented in Table I, p. 144. A20-75 resin is a low density material containing a plurality of epoxy groups, present in both internal and terminal positions, and attached to the backbone of an aliphatic hydrocarbon chain. This is distinguished from commercial epoxy resins where only two epoxy groups are present, both terminal and part of a glycidyl ether chain (Fig. 1). Additional functionality is provided in the A20-75 resin by the presence of hydroxyl groups and double bonds. Molecular weight, backbone structure, degree of branching, amounts of epoxy, hydroxyl, and double bonds present, and relative positions can be varied.

The reactivity of epoxy groups with specific reagents is markedly affected by the structural position of the epoxy groups and neighboring group influences. The ether linkage in the glycidyl ether type resins exert a strong inductive effect (electron attracting) causing a lowered electron density at the first carbon of the epoxy group. As a consequence this type structure is subject to nucleophilic

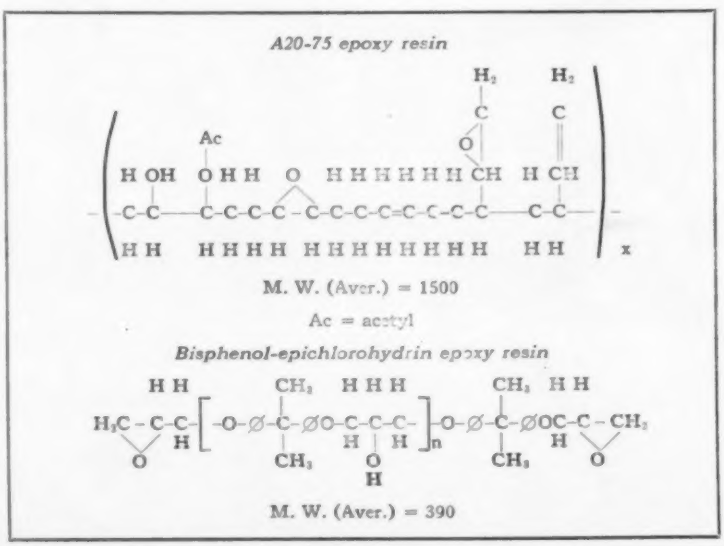

FIG. 1: Structure of new (top) and standard epoxy resin (bottom).

*Chemicals & Plastics Div., Food Machinery & Chemical Corp.
**Central Research Laboratory, Food Machinery & Chemical Corp.
This paper was presented at the 15th Annual Technical Conference of the Society of Plastics Engineers, January 1959.
[1]Numbers in parentheses link to references at end of article, p. 226.

Table I: Typical properties of uncured A20-75 resin

Appearance	Colorless to light amber liquid
Viscosity at 25° C., poises	900 to 2700
Active ingredients, %	100
Chemical composition	Resinous polyepoxide with internal and external epoxy groups
Backbone structure	Aliphatic hydrocarbon
Specific gravity	1.01
Epoxy, %	8.0 to 10.0
Epoxy equivalent	160 to 200
Hydroxyl, %	1 to 4
Iodine number	170 to 200

attack by a Lewis base reagent. Thus these resins react readily with polyamines, e.g., diethylenetriamine, even at room temperature. By the same token, however, they do not cure rapidly with acidic compounds such as dibasic acids and anhydrides, and elevated temperatures, catalysts, and long cure times are required.

The epoxy groups of the A20 resins are, in contrast, more readily attacked by electrophilic than by nucleophilic reagents, the initial reaction with an acidic group occurring at the epoxy oxygen. This is a consequence of the greater electron density at the C-O bond of the epoxy group. Internal epoxy groups in turn react more rapidly with acidic groups than do external groups and the opposite occurs with basic cure agents. Thus, A20-75 resin may be readily cured with acidic compounds such as dicarboxylic acid anhydrides even at room temperatures. In contrast, this resin reacts slowly with polyamines at room temperatures but rapidly at elevated temperatures.

Distinguishing characteristics of A20-75 resin are as follows:

1) Reactive with a variety of active hydrogen compounds.

2) Low density. Uncured resin is approximately 20% lower in density than conventional epoxies with corresponding values for cured materials.

3) Polyfunctional, containing reactive epoxy and hydroxyl groups and double bonds.

4) Inactive with polyamines at room temperature; readily reactive at elevated temperatures.

5) Long pot life with polyamines; lends itself to one package formulation possibility as well as preparation of storage stable epoxy prepregs.

6) Enhanced reactivity with anhydrides and dibasic acids. Room temperature curing systems are available.

7) Improved high temperature aging resistance.

8) Can be formulated to give cured products of varied flexibility dependent upon curing agent and conditions of cure.

9) Low shrinkage.

10) Employs large quantities of low-cost curing agents giving both economies and low viscosities.

Curing agents

The high functionality of the A20-75 resin provides numerous sites for crosslinking. The resin can be cured through the epoxy and/or hydroxyl groups to a thermoset resin by polyfunctional active hydrogen compounds, e.g., polyamines, dibasic acids and anhydrides, polyols, polymercaptans, and polyphenols. Some epoxy-hydroxyl group interaction is believed to occur simultaneously. Additionally, crosslinking through epoxy-epoxy and/or epoxy-hydroxyl group interaction can be carried out with a Lewis acid type catalyst complex of BF_3. The presence of reactive double bonds provides further sites for graft polymerizing with a vinyl monomer, e.g., styrene, thereby modifying the base epoxy resin. Crosslinking may be carried out selectively by one of the curing systems used alone or by stepwise or concurrent use of different curing agents.

The curing behavior is best described by reference to specific cure systems.

Polyamines: The resin can be cured effectively with aliphatic and aromatic polyamines to produce products with excellent tensile and flexural strength, satisfactory heat distortion temperatures, and superior age resistance. Aliphatic and aromatic polyamines are inactive towards epoxy resin A20-75 at room temperatures, even in the presence of acidic or basic catalysts. These systems are, accordingly, characterized by long pot life at low temperatures. In contrast, fast cures are achieved at elevated temperature. Generally, 2 to 4 parts of phenol per 100 parts of resin are employed as catalyst. Typical mechanical and electrical test data for the epoxy resin in the triethylenetetramine and *m*-

Table II: Properties of A20-75 resins cured with polyamines

	Triethylenetetramine	*m-Phenylenediamine*
Cure recipe		
Polyamines, parts/100 resin	31	32
Phenol, parts/100 resin	2	2
Cure schedule		
At 115° C., hr.	2	0
At 150° C., hr.	2	4
Properties[a]		
Flexural strength[b], p.s.i.	12,000	16,000
Flexural modulus, p.s.i.	340,000	390,000
Flexural elongation[c], %	5.3	5.9
Tensile strength[d], p.s.i.	5,000	7,000
Tensile elongation, %	4.5	6.5
Heat distortion temp.[e], ° C.	75	90
Postcured 24 hr. at 155° C.	90	108
Dielectric constant, 10^7 cycles	3.9	
Dissipation factor, 10^7 cycles	0.036	
Loss factor, 10^7 cycles	0.140	

[a] A minimum of two specimens was used in all tests.
[b] ASTM D 790. The castings were milled to bar dimensions of ½ by ⅛ by 3 inches.
[c] Maximum strain in percent (ASTM D 790).
[d] ASTM D 638; speed of testing 0.05 in./min. The castings were milled to 1/16 by 1/2 by 2 in. and necked down to ¼ in. over a ½ in. space.
[e] ASTM D648; 264 p.s.i. fiber stress. The castings were milled to ½ by ¼ by 3 inches.

Table III: Properties of A20-75 resin cured with maleic anhydride

Cure recipe	
Maleic anhydride, parts/100 resin	26
Cure schedule	
At 90° C., hr.	2
At 115° C., hr.	4
Properties	
Flexural strength, p.s.i.	10,100
Flexural modulus, p.s.i.	340,000
Flexural elongation, %	3.5
Tensile strength, p.s.i.	4,000
Tensile elongation, %	4
Heat distortion temp., ° C.	90
Postcured 24 hr. at 155° C.	211

Table IV: Properties of A20-75 resin cured with maleic anhydride and propylene glycol

Cure recipe	
Maleic anhydride, parts/100 resin	30.8
Propylene glycol, parts/100 resin	8.0
Cure schedule	
At 70° C., hr.	0.5
At 115° C., hr.	3.0
Properties	
Flexural strength, p.s.i.	14,000
Flexural modulus, p.s.i.	370,000
Flexural elongation, %	5
Tensile strength, p.s.i.	6,000
Tensile elongation, %	3
Heat distortion temp., ° C.	65
Postcured 24 hr. at 155° C.	110
Dielectric constant, 10^7 cycles	3.1
Dissipation factor, 10^7 cycles	0.016
Loss factor, 10^7 cycles	0.050

phenylenediamine cure systems are given in Table II, p. 144. Aliphatic polyamines react more rapidly with A20-75 resin than do the aromatic polyamines.

The age resistance of A20-75 resin at 155° C. (311° F.) was evaluated by the change in tensile strength measured at room temperature. After 350 hr. at 155° C., the tensile strength of A20-75 resin cured with *m*-phenylenediamine had decreased from 7000 to 4600 p.s.i. Under the same conditions, a commercial epoxy resin cured with *m*-phenylenediamine degraded to a brittle mass incapable of further testing.

Dicarboxylic acid anhydrides: Anhydrides, unlike polyamines, react very rapidly with A20-75 resin, even at low temperatures, to yield hard resins. These resins can be postcured to high heat distortion temperatures. The dicarboxylic acid anhydride reacts initially with the hydroxyl group of the resin to form a half-ester of a dicarboxylic acid and the resultant carboxyl group reacts with the epoxy oxygen of the resin to form a crosslink. Cure is rapid at temperatures of 90 to 115° C. Some of the high melting anhydrides can be blended easily only with A20-75 resin of relatively low hydroxyl content. Liquid anhydride or eutectic anhydride mixtures allow for ready incorporation of curing agent at low temperatures. Typical mechanical test data for A20-75 resin cured with maleic anhydride are shown in Table III, above.

Anhydride-polyol systems: Epoxy resins cured with anhydrides tend to be hard and somewhat brittle unless properly modified. The resins may be flexibilized by blending with an anhydride containing a long aliphatic side chain, e.g., dodecenylsuccinic anhydride, or with a saturated anhydride, or by the addition of a long chain fatty acid. Another method of increasing the toughness of anhydride cured resins consists of the addition of polyols to the resin. Glycols have previously been described (11,17) as catalysts for the cure of other epoxy resins with anhydrides. With A20-75 epoxy resin, glycols serve primarily as flexibilizers but also unexpectedly increase the flexural and tensile strength of the resin. Variables in the anhydride-glycol systems provide considerable flexibility with respect to the specific anhydride and glycol used, the ratios employed, as well as the ratio of curing agents to resin. In general, high ratios of cure agent to resin decrease pot life, lower the temperature of cure, and **(To page 226)**

Table V: Effect of amount of cure agent upon properties of A20-75 resin

Cure recipe					
Maleic anhydride, parts/100 resin	25.7	30.8	41.2	51.4[a]	51.4[a]
Propylene glycol, parts/100 resin	6.6	8.0	10.8	13.2[a]	13.2[a]
Cure schedule					
At room temp., hr.	—	—	—	0	3
At 70° C., hr.	0.5	0.5	0.6	—	—
At 90° C., hr.	—	—	—	1.8	0.5
At 115° C., hr.	1.5	3.0	2.0	—	2.0
Properties					
Flexural strength, p.s.i.	10,400	14,000	14,700	14,800	12,100
Flexural elongation, %	4.3	5	5.2	5.2	4.4
Flexural modulus, p.s.i.	300,000	370,000	380,000	380,000	330,000
Heat distortion temp., ° C.	50	65	65	—	—
Postcured 24 hr. at 155° C.	95	100	120	—	—

[a]Cure agents premixed.

Table VI: Properties of A20-75 resin cured with polyphenol

	Resorcinol	*Bisphenol A*
Cure recipe		
Polyphenol, parts/100 resin	29	62
Phenol, parts/100 resin	2	2
Cure schedule		
Temperature, ° C.	115	115
Time, hr.	6	35
Properties		
Tensile strength, p.s.i.	6,500 to 7,000	4,000 to 4,500
Tensile modulus of elasticity	140,000	100,000
Tensile elongation, %	8 to 9	6 to 7

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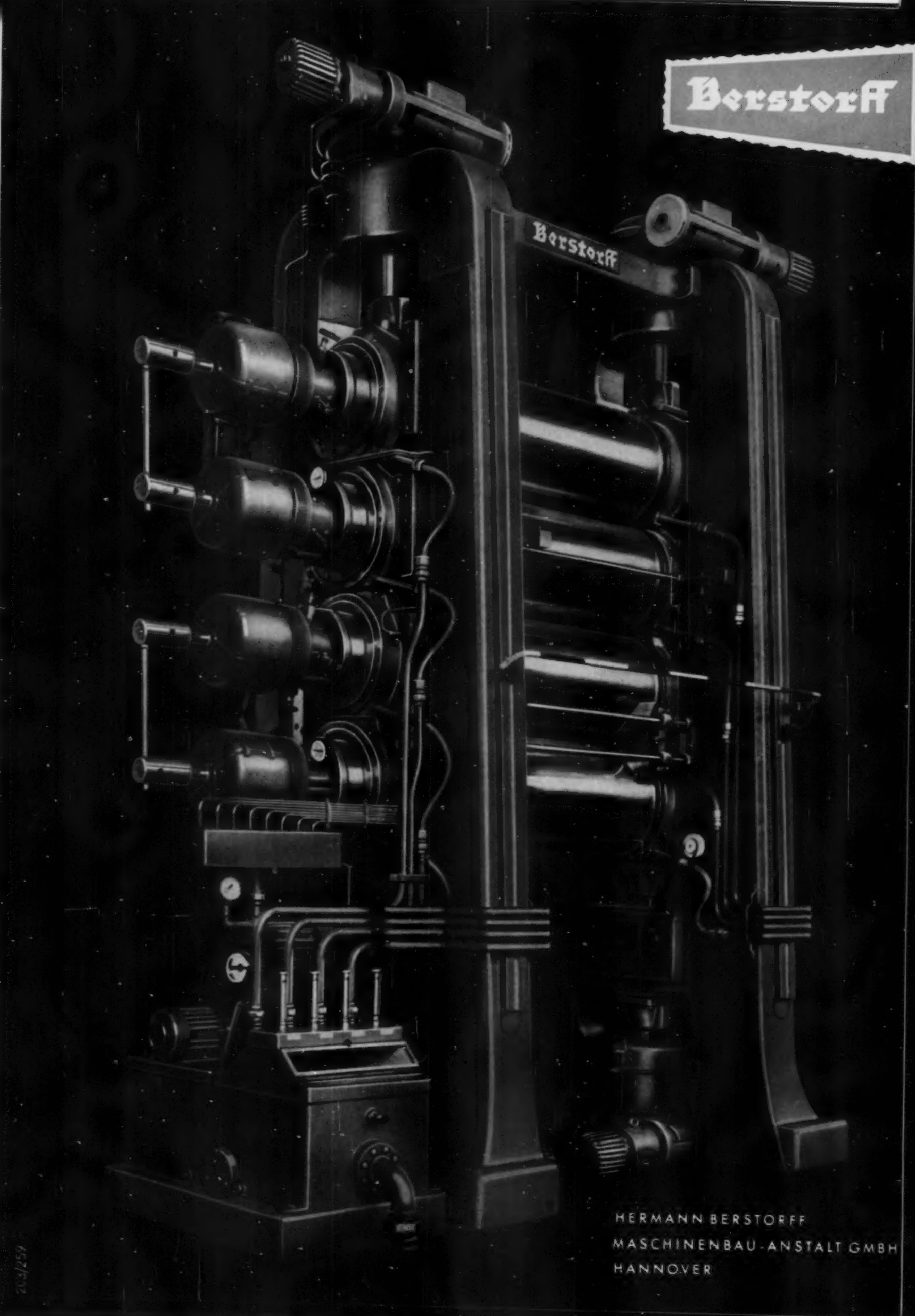
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An unusual feature of the job was the elimination of all intermediate fitting by installing the tubing in continuous lengths from centralized panels to field instruments and valves. Maximum run in this facility was 325 ft.; however, runs up to 1000 ft. are possible. Right-angle clips and multi-tube support brackets were used to facilitate installation.

Behind-panel piping, as neat and orderly as copper piping, was more easy to follow because the nylon tubing was color coded in accordance with Instrument Society of America standards.

In addition to cost savings, the nylon tubing offers corrosion and kink resistance, low-temperature impact strength, toughness, and abrasion resistance.

OVER-ALL VIEW of a portion of nylon-tubing air controlled system. Switch from copper to nylon brought over-all savings of approximately $30,000.

Decorative film

A newly-styled decorative material from Coating Products, Inc., Englewood, N. J., is based on Mylar transparent polyester film.

The complete process involves vacuum metallizing of the film, pattern embossing, adding of dull finish rayon flock, with or without glitter, and laminating to vinyl or other backings. The material, known as Mirro-Brite Fiesta Mylar, is also supplied with pressure-sensitive adhesive.

The standard flocking is a ¼-in. wide stripe, although several flocking widths can be ordered. The finished material is available in continuous rolls, 54 in. wide, or in cut-to-size sheets. Uses include eyeglass cases and handbags.

Urethane scrap cushion

Self-inflating cushion consists of a core of polyurethane foam scraps as well as a covering of vinyl sheeting.

By pulling open a small valve on one corner of a deflated cushion, air is automatically let into the foam interior, and inflates the pillow. If a softer cushion is desired, the air can be squeezed out and the valve closed when the proper softness is reached. The air can also be completely ejected, and the cushion rolled up compactly for carrying.

Waterproof, the cushion is suggested for outdoor applications. It retails for approximately $3, and is available in metallic tweed patterns as well as decorative prints.

Calendered vinyl sheeting for the covering is supplied by the Firestone Tire & Rubber Co., Akron, Ohio. The cushion, known as the Foamatic, is fabricated and marketed by Holiday Line, Inc., New York, N. Y.

Ballcock valves

Two different plastics materials—nylon and styrene copolymer—are now being used to produce ballcock toilet valves. The plastics valves are either competitive or lower in price than conventional all-metal valves, and also offer mechanical advantages as well as complete freedom from corrosion. The latter point is of particular importance to the application because of constant exposure to water when in use.

The mechanical advantages of the new valves stem from the fact that they are designed to close *with* the water pressure rather than *against* it; thus they seat quickly and seal tightly without the necessity of using complicated compound levers, such as are common in metal valves that must seat against the force of the water pressure.

The nylon valve is assembled from parts injection molded of Plaskon 8200 material by The Hydo Valve Corp., Austin, Texas. It retails at about the same price as conventional metal valves, yet is claimed to give far longer life, greater freedom **(To page 152)**

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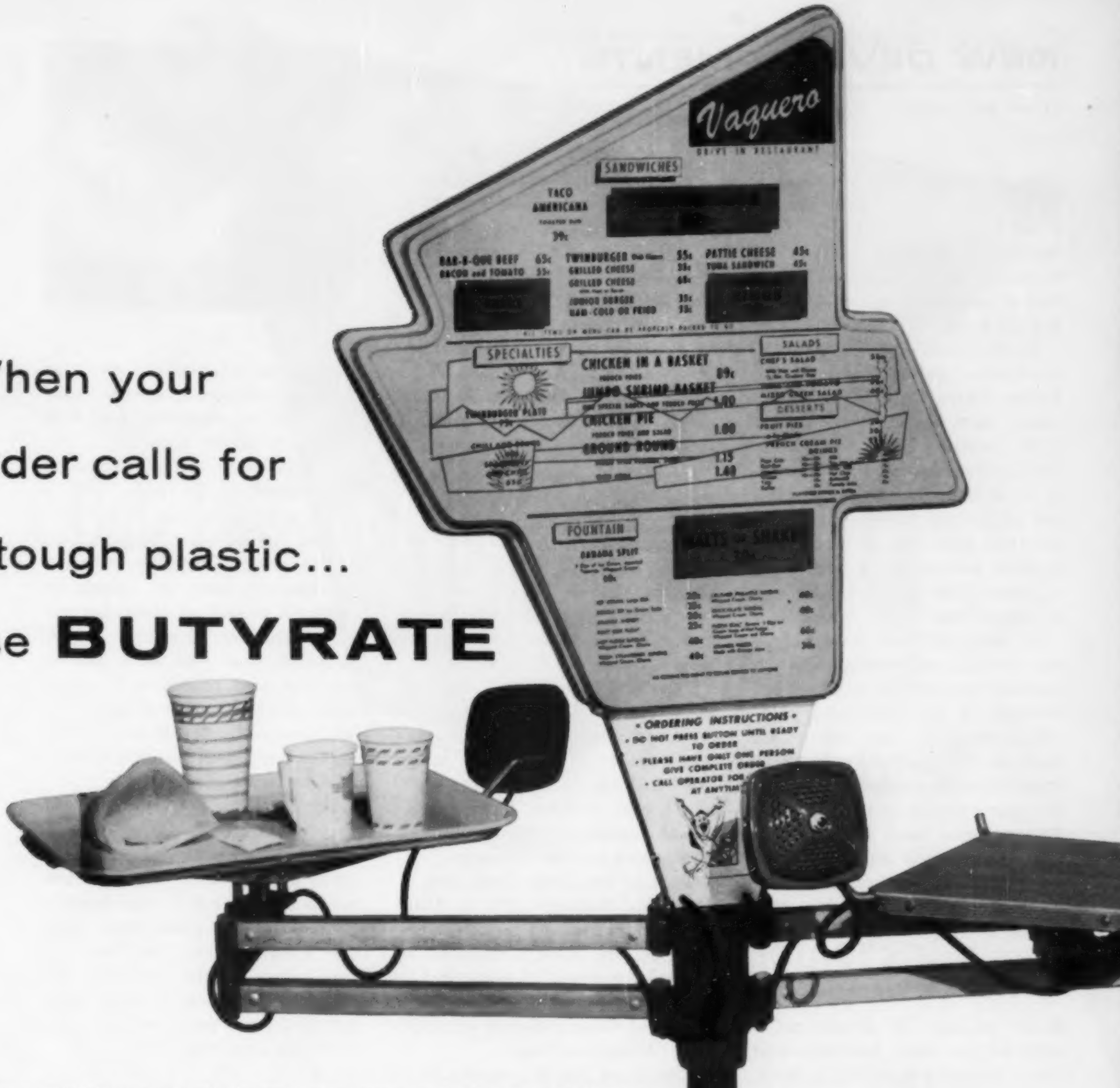


Hungry motorists can see what's good at a glance with this internally lighted, double-faced menu sign. It is part of a new electronic ordering system that speeds service at drive-in restaurants. Each unit includes the sign and two microphone speakers, all vacuum-formed from sheet extruded of Tenite Butyrate plastic.

In a special weather-resistant formulation of Tenite Butyrate, the manufacturer found a plastic material that would endure outdoor exposure, even in severe climates. Butyrate is the same plastic that has repeatedly proved itself in such rugged applications as oil field pipe, football helmets and marine floats.

Butyrate's superior toughness in relation to sheet thickness often permits use of lighter gauges. But this isn't the only economy that Butyrate offers manufacturers. An easy-working thermoplastic material, extruded Butyrate sheet can be rapidly formed on fast-cycle machines with no need for preheating in special ovens. Decoration is readily applied either before or after forming.

Explore the advantages of using Tenite Butyrate in your operations. For further information, write: EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE BUTYRATE
an Eastman plastic

The Car-Call, Sr., ordering system is manufactured and sold by Car-Call Electronic Ordering Systems, 249 North 48th St., Lincoln, Neb. The menu sign and speaker housing are vacuum-formed from sheet of Tenite Butyrate by Premier Plastics Corporation, Milwaukee 4, Wis., and Hutcheson Displays, Inc., Omaha, Neb., respectively.

(From page 150)

from trouble, reduced noise at shut-off, shorter fill time because it stays open at full flow until the instant of shut-off, and water economy because of the elimination of seepage made possible by the tight seal of the nylon parts.

Similar claims are made for the copolymer valve produced by Fulton Valve Co., Fulton, N. Y., using parts injection molded of U. S. Rubber's Kralastic material by Auburn Plastics, Inc., Auburn, N. Y. It is further stated that the use of plastics, combined with the resulting high rate of production, permits pricing the **Fulton valve** at about 70% less than the cost of comparable metal valves.

In both of these new valves, the opening and closing action is initiated by ball floats. However, because of the hydraulic principles involved, the valves are held in the closed position by water pressure rather than by the leverage exerted by the float. The Fulton valve uses any conventional toilet tank ball; the Hydo valve is furnished complete with a compact polyethylene float only 1¾ in. in diameter.

PE playboat

Eight pounds of linear polyethylene are sheet thermoformed into a 5-ft. playboat with a 28-in. beam and 9-in. draw. Lightweight construction permits easy portability by children, yet the boat is rigid and rugged enough to support up to 160 pounds.

Jewel City Products Co., Los Angeles, Calif., thermoforms the 156-mil sheets on a three-station Comet rotary machine operating on a 2-min. cycle. Sheets of Marlex (Phillips Chemical Co.), are supplied by Kal-Western Plastics, Inc., Pico Rivera, Calif., for this application.

The craft retails for $29.95, and is available with a $3.29 vinyl sail and a $1.69 wooden paddle. Technical Plastics Co., Culver City, Calif., engineered and is marketing the boat.

Keeps food frozen 36 hours

Salesmen who carry frozen food as part of their product line will welcome a new lightweight insulated car chest made of foamed polystyrene. The 2-in. thick walls of the chest permit the keeping of frozen foods without dry ice or a refrigerant of any kind for as long as 36 hr., even while temperatures up to 90° F. prevail. It is also suitable for products which require the maintenance of a constant hot temperature.

Part of the Freez/Safe line of Polyfoam Packers Div. of Glo-Brite Foam Plastic Products, Chicago, Ill., the chest is designed to fit into the trunk of a car and is molded in one piece from Dow Chemical Co.'s Pelaspan expandable polystyrene beads.

The chest has a capacity of 2 cu. ft. with outside dimensions of 20 by 20 by 17 in., inside dimensions of 16 by 16 by 13 in., and holds up to 75 lb. of frozen foods and similar products. It can be supplied in a fiberboard case at $14.75, or in Royalite at $39.75.

Teflon dope

Teflon tape for pipe sealing has made possible virtually leakproof joints, replacing lead and oil combinations and the accompanying messy cans and brushes normally used for "doping" pipe threads. Designated Dri-Seal No. 5 and supplied by Chemtrol, Lynwood, Calif., the sealant is said to withstand almost any chemical used in an industrial piping system; it is also reported to be non-con-

taminating to potable water systems or critical chemical solutions. It is suggested for both metal and plastic pipe.

One full turn of the tape around the thread of the pipe, with a small overlap at each end is sufficient for sealing. The waxiness of the material supplies sufficient lubrication and its plasticity allows it to seal off clearance between threads. The tape is said to resist heat and cold, not to dry out, and to retain its plasticity. Galling and sticking of the joints—a problem that is normally encountered with stainless steel—is reportedly eliminated.

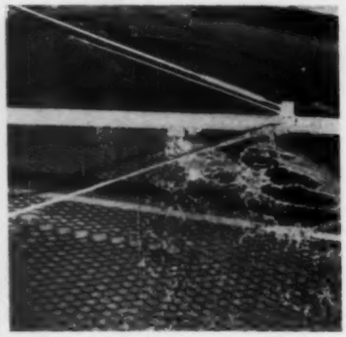
Dri-Seal No. 5 is furnished in ½-in. width, with 300 in. in each roll, sufficient for doping 120 joints of 1-in. pipe size. Cost per roll is $1.60. This is considerably higher than standard dope. But the manufacturer justifies the high price by the fact that his system makes possible more positive leakproof paint, even in gas or vacuum systems.

More effective filter

Square sections of corrugated saran sheet (Dowpac) are used instead of standard rock beds in a waste water filtration tower at the new Cities Service Oil Co. refinery near Toronto, Canada.

The packed filtering material utilizes a phenomenon of nature in which certain bacteria purify water by living on pollution and converting it into carbon dioxide and water.

Standard rock filter beds lose much surface area where the rocks come into contact with one another. Also, because of restricted ventilation, and plugging from excessive waste accumulation, rock beds are seldom effective beyond 6 feet. **(To page 154)**



WATER-BORNE waste is filtered and water purified by trickling it over these honeycomb sections formed from heat-fused saran sheets.

The new Dowpac system, with its uniform corrugated shape, provides greater surface area and excellent aeration. These advantages, plus the plastic's light weight, permit efficient water filtration through the tower depth of 20 feet.

Saran sheets, supplied by Dow Chemical Co., are corrugated and heat-fused one to another to form the square sections. Approximately 50 such sections are packed into the tower, which has a diameter of 17 feet. Outer sections are trimmed to conform to the circular tower.

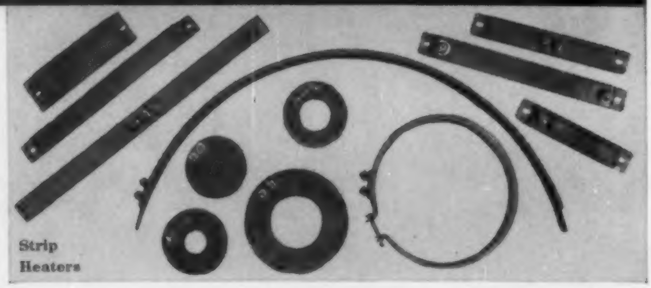
Waste-bearing water is treated at a rate of from 300 to 600 gal./min., and is eventually piped into Lake Ontario.

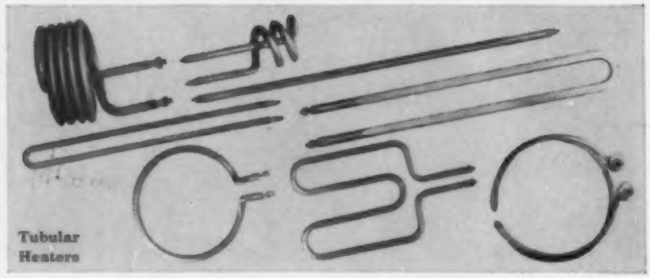
Superior mat from PE

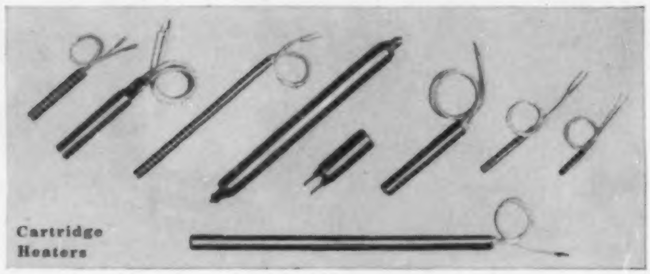
Durability, low cost, and superior utility are claimed for a new line of reversible polyethylene door mats produced by Plastray Corp., Walled Lake, Mich.

The mats are injection molded of a mixture of **(To page 157)**

Call your CHROMALOX Man for the heating answers







These 3 basic CHROMALOX heaters provide answers to just about any heating problem

Strip Heaters . . . that quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens and air ducts. Lengths from 4 to 96 inches, widths from ¾ to 2½ inches, with cross section curving or lengthwise bending. Available with brazed-on fins.

Tubular Heaters . . . that clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Available with brazed-on fins.

Cartridge Heaters . . . that smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Special leads available for protection against flexing action, abrasion, moisture or vapors. Diameters from ⅜ to 1$^{19}/_{64}$ inches, lengths from 1⅝ to 25⅜ inches.

Versatile Chromalox electric heaters are available in sheath materials and wattages to match almost any application to 1100°F. Easy to install, they are fast, clean, safe and economical.

Each has particular advantages. Your Chromalox Man can help you determine the one that best answers your specific problem. He's backed by the world's largest factory stock of industrial heaters, ready for immediate shipment. Why not give him a call. You'll find his phone number listed at the right.

Our new Catalog 60 provides detailed product information and suggests numerous applications for the complete line of Chromalox electric heaters for industry. If you have not yet received a copy, please let us know.

7760

CHROMALOX
Electric Heat
INDUSTRIAL • COMMERCIAL • RESIDENTIAL
EDWIN L. WIEGAND COMPANY
7503 Thomas Boulevard • Pittsburgh 8, Pa.

Grex high-density and conventional polyethylenes and are available in a range of molded-in colors. Retail price is $1.98, size 17 by 23 inches. The weight is less than a pound.

The open-grid design and the use of high-density material gives the mat good strength and permits efficient scraping action to get shoes clean.

Precision at less cost

An adapter plate and snap action switch for jet engines, compression molded of flock-filled medium impact phenolic, insures operation up to 1/1000 of an inch, and is 50% cheaper than the metal previously used.

Because the adapter plate and the snap action switch are made of the same material and with the identical moisture absorption capacity, humidity changes in the engine do not interfere with the precision tolerances that are needed to indicate manifold pressure to pilots.

The adapter plate was developed by Overland Machined Products Co., Los Angeles, Calif., and Peerless Plastics Co., Culver City, Calif.

Cards that last

All-plastic playing cards, a single deck of which is said to outlast 573 ordinary decks of playing cards, and which may be "laundered" in an automatic washer without damage, are now in production by Northbrook Plastic Card Co., Northbrook, Ill., which is a division of Arrco Playing Card Co.

Called Nor cards, they consist of an undisclosed plastic (rather than paper) core which carries the printing, laminated on both sides with a layer of Mylar polyester film. This combination of materials results in a card that is said not to crack, warp, chip, fade, or support combustion. Under a lifetime replacement guarantee, the entire deck is replaced free if the printing on the cards should ever fade or wear off.

In a series of tests by United States Testing Co., Inc., the Nor cards reportedly survived over 3700 cycles of the (To page 158)

Taber abraser, against a little over 250 cycles for other plastics cards.

In another test, the cards were held for seven days in an oven heated to 158.2° F. At the end of that period, flexural strength was found reduced by 7%, against 57% for another all-plastics card. Retailing at $10 for two decks, the Northbrook playing cards are available nationally in department stores and other retail outlets in four different patterns: fleur-de-lis, jungle bird, berry branch, and temple dancer.

Magazine-record rack

Combination magazine and phonograph rack is molded of high-density polyethylene. Made in two pieces and hinged at the bottom, the unit expands and contracts as periodicals and records are added or removed. Built-in tension within the rack holds the items securely in place.

COMBINATION magazine-record rack is molded of high density polyethylene. Two-piece rack is hinged at bottom and designed with "tension-hold" action which holds items firmly in place.

Loma Plastics, Inc., Fort Worth, Texas, injection molds the Mag-Rac on a 48-oz. HPM press. A two-cavity mold is used, and shot weight is 515 grams. High density polyethylene material is supplied by Polymer Chemicals Div., W. R. Grace & Co., Clifton, N. J.

Retail price for the rack is $5.98, and it is available in five colors: pink, parchment, copper, turquoise, and black.—**End**

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Source Book of the New Plastics—Volume I", *Edited by Herbert R. Simonds.*

Published in 1959 by the Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 354 pages. Price: $10.00.

The bulk of this book consists of a series of 60 articles contributed by well known material suppliers in the plastics field. The reports are arranged alphabetically by contributing company name and each paper describes the recent developments in materials (and some processes) taking place at each company. When used with the index, information can be found by either knowing the name of the company producing the product or the name of the product itself. Brief descriptions of the newer plastics such as acetal, ethylene oxide, methylstyrene, polyacrylamides, polycarbonate, polyether and propylene resins are given in the first chapter and keyed into more detailed descriptions by the suppliers in this report. The book also has chapters on new developments in the older materials, federal government sponsored research and 100 selected patent references on new polymers. A good summary of who's doing what.—*G.R.S.*

"France-Plastiques."

Published in 1959 by Creations Editions Productions Publicitaires, 27 Rue Laffitte, Paris 9e, France. 1178 pages. Price: 2800 F. ($6.75).

The 11th edition of this annual yearbook on the French plastics industry includes a listing of material makers, machinery and equipment manufacturers, molders, fabricators, importers and distributors, etc. The encyclopedia further lists trademarks, manufacturers' societies, educational institutions, personalities, etc.

"Heat Sealing and High Frequency Welding of Plastics" *by Hans Peter Zade.*

Published in 1959 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, New York. 211 pages. Price: $5.75.

The book opens with brief discussions on the sealability of practically all the known thermoplastics including polypropylene. Property charts on each material (17 in all) are included. Sealing with heat and sealing with high frequency electrical energy is given. The theory, equipment, and applications for both processes are covered in separate chapters. Forty-eight page section at the end of the book presents a comprehensive list of world patents, tradenames and a glossary of terms used in the book. A handy reference book for those interested in the welding of plastics. Illustrated.

"Printed Circuits," *by Dipl.-Ing. G. Siedel.*

Published in 1959 by VEB Verlag Technik, Berlin C 2, Oranienburgerstr. 13/14, Germany. 224 pages. Price: DM 15.00 ($3.75). In German under the title "Gedruckte Schaltunger — Technologie und Technik."

This volume is intended to introduce the basic concepts of printed circuits to the novice; to give the more experienced reader an overall picture of the field; and to serve as a reference book for the expert. In addition to step-by-step descriptions of every aspect of printed circuit manufacture, the author carefully explains the reasons for using printed circuits, and the differences between the various processes and laminates employed in this field.

Vacuum forming. "Meet the Nations' Top Vacuum Former" illustrates the step-by-step procedure in thermoforming and assemblying displays, toys, industrial parts, lighting fixtures, and packaging items, and depicts various products made by the firm. 8 pages. *Chanal Plastics Corp., 63-20 Austin St., Rego Park 74, N. Y.*

Density determination. "Heavy Liquids for Sink-Float Density Determinations in Quality Control and Research" describes both aqueous and organic liquids used to identify plastics and other substances. 12 pages. *Engineered Materials, P. O. Box 363, Church St. Station, New York 8, N. Y.*

Cold-Weather Research and Testing Facilities. Brochure describes facilities available for testing of plastics and other materials under cold weather conditions. 20 pages. *Gorham Labs., Inc., Gorham, Maine.*

Caprolactam. Physical and chemical properties, uses, physiological properties and handling, storage, etc., for caprolactam, used in the production of nylon. Includes 197-item bibliography. Technical Bulletin I-14R. 34 pages. *National Aniline Div., Allied Chemical Corp., 40 Rector St., New York 6, N. Y.*

Plastics pipe, casing. "Plastic Casing for Water Wells" gives preassembly and installation information, specifications, uses, and similar data. 2 pages. "Plastic Pipe for Use in the Oil Country." 6 pages. "Chem-Weld Drainage Pipe." 4 pages. *Southwestern Plastic Pipe Co., P. O. Box 117, Mineral Wells, Texas.*

Fluorescent pigments. Production facilities, uses, markets, etc., for Hi-Viz fluorescent additives for plastics. 12 pages. "Hi-Viz Fluorescent Pigments" gives physical and chemical characteristics, colors available, prices, applications, color samples, etc. 4 pages. *Lawter Chemicals, Inc., 3550 Touhy Ave., Chicago 45, Ill.*

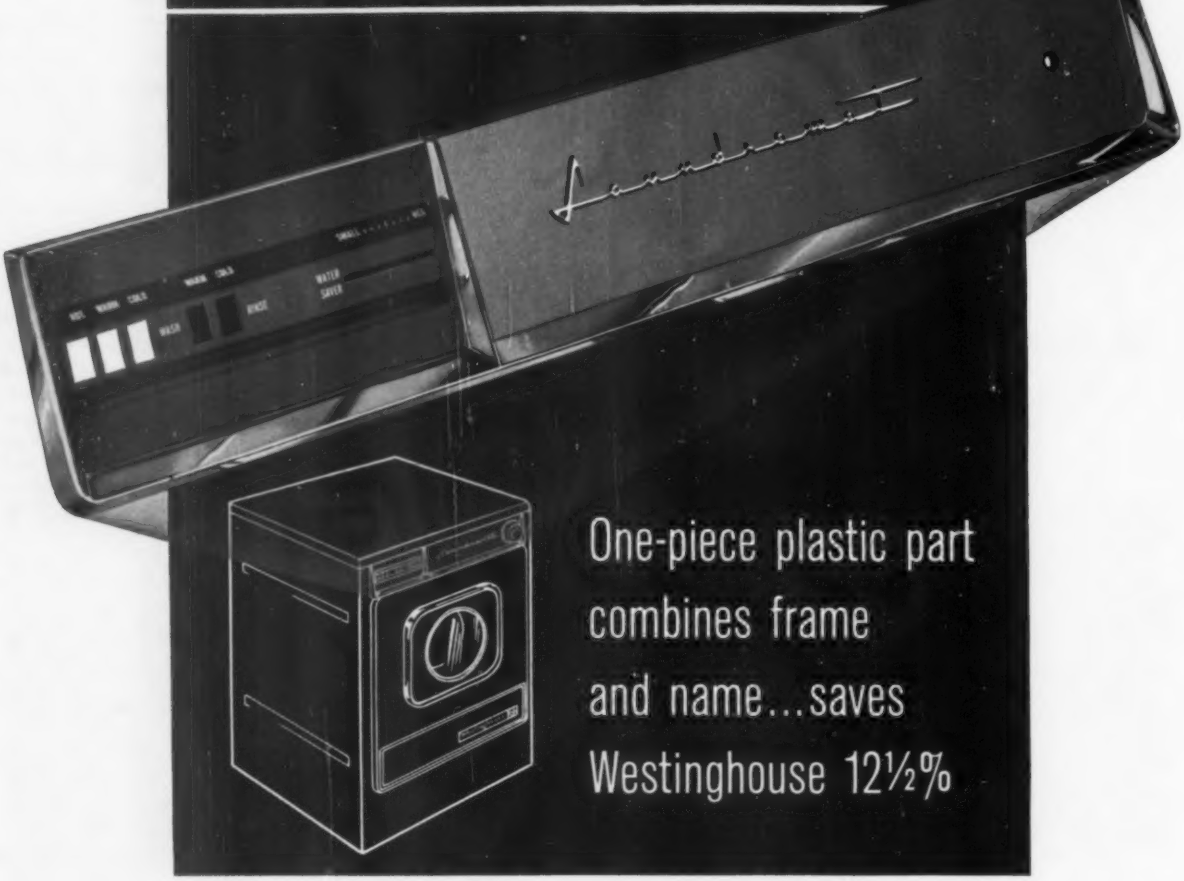
Heat Erosion Characteristics of Reinforced Plastics. Describes the properties of reinforced plastics resin systems which are used as ablation materials. Bulletin 2.15. 3 pages. *Zenith Plastics Co., 1600 W. 135th St., Gardena, Calif.*

Light stabilized polystyrene. Description and properties, fabrication methods, injection molding, extrusion, degradation and light stability, accelerated testing, and conclusions regarding Styron 672 and 673 Verelite light-stabilized polystyrene. 12 pages. *The Dow Chemical Co., Plastics Dept., Midland, Mich.*

Acetophenone. Physical properties, shipping data, specifications, solubility, applications, typical reactions, and other technical data on acetophenone (methyl phenyl ketone, acetylbenzene), which reacts to form a variety of derivatives useful as resins, corrosion inhibitors, pharmaceuticals, etc. 12 pages. *Union Carbide Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Extrusions. Two double-sheeted brochures, designed to fit loose-leaf notebooks, depict about 200 custom-designed and standard rigid extrusions (acrylic and polystyrene) available for lighting or other industrial uses. Cross- **(To page 164)**

ERIE-nomics at work...



This identification panel made by Erie Plastics Division for the Westinghouse "Space-Mate Laundromat" is a big part . . . 77 square inches of surface. And an interesting part . . . combining a 3-D metallized frame and a vacuum-deposited 3-D gold name plate. Its assembly to the machine is done by simply pushing-on fasteners over integral-molded studs.

And savings! Westinghouse estimates over 12% direct reduction in cost, compared to a conventional multi-piece assembly. Plus elimination of all the problems of complicated multi-piece-assembly inventories, designs, and damaged or out-of-stock parts.

ERIE-nomical Plastic Parts offer your designers many possibilities . . . top or rear-surface metallizing that is impervious to weather and laundry detergents . . . colorful 3-D decorations that harmonize with automobile and other color schemes . . . large industrial parts up to 120 ounces.

Write today for a booklet about Erie Plastics Division services. Tell us when you would like to see the man from ERIE.

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LITERATURE

(From page 160)

sectional shapes are actual size. 2 pages. *The Rotuba Extruders, Inc., 416 88th St., Brooklyn 9, N. Y.*

Metal acetylacetonates. Forms and properties, types, availability, uses, and literature references for a line of metal acetylacetonates, which are used as additives in plastics, rubber, etc., as catalysts and intermediates, and other uses. 4 pages. *Union Carbide Metals Co., P. O. Box 330, Niagara Falls, N. Y.*

Ultraviolet absorber. Description, solubility, absorption spectrum, heat and light stability, chemical properties, toxicity, and similar data for Tinuvin P, a new benzotriazole ultraviolet absorber. 4 pages. *Geigy Industrial Chemicals, P. O. Box 430, Yonkers, N. Y.*

Epoxy resin potting compound. Physical properties, prices, applications, etc., for a line of epoxy resin potting compounds. Technical Data Sheet 110-B. 2 pages. *Bacon Industries, Inc., 192 Pleasant St., Watertown 72, Mass.*

Resins. Properties, uses, general characteristics, mixing and curing instructions, performance data, etc., for a line of epoxy resins, curing agents, casting resins, gel coats, laminating resins, parting agents, polyester resins, solvent strippers, and other compounds. 52 pages. *Resin Formulators, Inc., 8956 National Blvd., Los Angeles 34, Calif.*

Fibrous glass structures. Features, physical data, facilities, etc., for a line of filament-wound fibrous glass structures, which serve as radomes, nose cones, torpedo bodies, solid propellant rocket motor cases, structural tubing, and casings. 8 pages. *Aviation Div., Walter Kidde & Co., Inc., Belleville 9, N. J.*

Nylon film. General, thermal, optical and mechanical properties; permeability of films to water vapor, gas, and odor; and other comparative properties of M & Q nylon film compared with other commercially available materials. 2 pages. *M & Q Plastic Products, Freehold, N. J.*

Ethylene-maleic anhydride copolymers. Types available, physical properties, preparation of solutions, titration, ion tolerances, viscosities, pH effect, film properties, applications, etc., for a line of water soluble copolymers of ethylene-maleic anhydride, which are commonly used in adhesives, dispersants, and textile sizes. Bulletin 1066. 14 pages. *Monsanto Chemical Co., Plastics Division, Springfield 2, Mass.*

Epoxy resins. "A Method for Determining the Epoxy Content of Cured and Uncured Resins." PB 151150. 20 pages. Price: 50 cents. "Synthesis of High-Impact Strength Adhesives from Epoxy Resins." PB 151128. 11 pages. Price: 50 cents. *OTS, U. S. Department of Commerce, Washington 25, D. C.*

Epoxy RP spray technique. "Fast-acting Epoxy Reinforced Plastics" describes new fast-cure epoxy systems and the newly developed spray equipment designed to handle them. Epoxy Technical Release 7. 8 pages. *Union Carbide Plastics Co., 30 E. 42nd St., New York 17, N. Y.*

Plastic aluminum, rubber. Brochure describes a line of specialty products, including plastic aluminum; plastic rubber; fibrous glass solder and repair kits; adhesives; etc. 4 pages. *The Woodhill Chemical Co., 1390 E. 34th St., Cleveland 14, Ohio.*

Air presses; motors. "The Hannifin Air Motor" gives specifications, cylinder and valve features, bore sizes, and other technical data. Bulletin 215. 8 pages. "Hannifin . . . at a Glance" describes a line of hydraulic presses, power cylinders, directional air control valves, compressed air preparation units, and other machinery for the plastics and other industries. Bulletin 601-B. 6 pages. *Hannifin Co., Des Plaines, Ill.*

Thermoforming machines. Specifications, uses, etc., for the Hydro-Chemie, Ltd. thermoforming machines. 4 pages. U. S. and Canadian distributor: *Conapac Corp., 120 E. 13th St., New York 3, N. Y.*

Plastic-aluminum insulating panel. Advantages and uses for Alply, an insulating panel consisting of expanded plastic beads sandwiched between sheets of aluminum, used in buildings, trailers, appliances, etc. 24 pages. *Aluminum Company of America, 1250-H Alcoa Bldg., Pittsburgh 19, Pa.*

Vibratory feeders. Specifications, uses, etc., for a line of electro-permanent magnetic vibratory feeders for precision feeding, spreading, sorting, aerating, cooling, sifting, mixing, etc. Bulletin VB-10-1. 6 pages. *Eriez Mfg. Co., Erie 6, Pa.*

Spray-on, strip-off coatings. Brochure discusses the applications and economics of spray-on, strip-off coatings in protecting sensitive finishes of plastics, metal, rubber, etc. 8 pages. *Spraylat Corp., 1 Park Ave., New York 16, N. Y.*

Principal Products and Sales Offices. Alphabetical listing of some 3000 products available from the firm, tradenames, and name of distributor where you can buy them. 8 pages. *Allied Chemical Corp., 61 Broadway, New York 6, N. Y.*

ABS polymer pipe. Typical properties, hoop stress, case histories, etc., regarding ABS polymer pipe in refineries and petrochemical plants. 8 pages. *Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

Polymer directory. Chemical properties, uses, etc., for the company's line of polymer products. 8 pages. *The Borden Chemical Co., 350 Madison Ave., New York 17, N. Y.*

Non-slip grips. Specifications, applications, etc., for Capstan grips, which grip hard to hold flexible sheet materials for tensile strength testing in plastics. Bulletin 119-TT. 2 pages. *Thwing-Albert Instrument Co., Penn Street at Pulaski Avenue, Philadelphia 44, Pa.*

Production facilities. Description of services and facilities, for production of industrial laminates, including printed circuits. 16 pages. *Northern Plastics Corp., La Crosse, Wis.*

Polypropylene. Physical properties, heat resistance, chemical behavior, and applications for the company's Poly-Pro polypropylene. 4 pages. *Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.*

Indicating recorders, controllers. Specifications, dimensions, uses, etc., for Thermo Electronic Model 80049 self balancing indicator. Bulletin 65. 4 pages. Similar data for Thermo Electronic indicating recorder. Bulletin 66. 4 pages. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

Decorative metallic flakes. Colors, shapes, uses, prices, etc., for Metalflake precision shapes from coated aluminum foil or acetate laminated foil, which have a variety of uses in plastics, textiles, paper, etc. Includes samples. **(To page 166)**

7 pages. *The Dobeckmun Co., P. O. Box 6417, Cleveland 1, Ohio.*

Physical testing instrument. Specifications, models available, uses, etc., for the standard and water-jacketed Penescope, which is used for testing the resistance of plastics films and other materials to penetration by water, inks, blood, and solutions of electrolytes and other liquids. Bulletin 371-ST. 2 pages. *Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.*

Ethylene carbonate. Physical properties, reactions, uses, toxicity, etc., for ethylene carbonate, a non-corrosive, non-hygroscopic, odorless, colorless solid, which is used in the preparation of polyester resins and resin intermediates. 16 pages. *The Dow Chemical Co., Technical Service & Development Dept., Midland, Mich.*

Caulking, glazing compound. Specifications, uses, packaging, and shipping data, colors, etc., for Kaukit, an alkyd resin based caulking and glazing compound. 4 pages. *L. Sonneborn Sons, Inc., 404 Park Avenue South, New York 16, N. Y.*

Chemicals. Descriptions, physical data, uses, shipping information, etc., for the company's line of chemicals many of these used in the plastics industry. Bulletin 100-C. 12 pages. *Hooker Chemical Corp., Box 344, Niagara Falls, N. Y.*

Controlled dispersion. "A Handbook of Mulling" explains the mulling principle of blending dry, semi-liquid and dry, and solid materials in the Simpson Mix-Muller, which is used to combine resins with colorants, plasticizers, and fillers. 12 pages. *Simpson Mix-Muller Div., National Engineering Co., Machinery Hall, Chicago 6, Ill.*

Vinyl coated steel sheet. Brochure describes how vinyl coated steel sheet is being used by four companies in making a variety of products. 4 pages. *United States Steel Corp., 525 William Penn Place, Pittsburgh 30, Pa.*

Pigments. Catalysts, applications, viscosity reduction, laminating procedures, price list, color chart, etc., for Ferro colored gel coats for reinforced polyester laminates. 8 pages. *Ferro Corp., Plastic Color Section, 4150 E. 56th St., Cleveland 5, Ohio.*

Masking materials. Specifications, uses, advantages, etc., for a line of masking aids, such as peelable plastics, yellow **(To page 168)**

plastic caps, masking discs, pre-cut spray masks, plugs, etc. Bulletin M-24. 4 pages, *By-Buk Co., 4314 W. Pico Blvd., Los Angeles 19, Calif.*

Polypropylene. Typical properties, as well as information on molding and extrusion, uses, etc., for AviSun polypropylene. 4 pages. *AviSun Corp., Marcus Hook, Pa.*

Extrusions. Lists stock profile dies and illustrates in silhouette the die shapes available for extruding them. 4 pages. *Conneaut Rubber & Plastics Co., Conneaut, Ohio.*

Radiamatic pyrometers. Describes the theory and fundamentals of radiation pyrometry, and the function, construction, and application of Radiamatic pyrometers. Catalog C93-1a. (Supersedes Catalog C93-1). 30 pages. *Industrial Division, Minneapolis-Honeywell Regulator Co., Wayne and Windrim Avenues, Philadelphia 44, Pa.*

White mineral oils. Definitions, properties, uses, etc., for a line of white mineral oils, which serve either as plasticizers, extenders, softeners, or lubricants during the hot roll mixing, depending on the resin involved. Technical Data File F-42. 1 page. *L. Sonneborn Sons, Inc., 300 Park Avenue South, New York 10, N. Y.*

Plastics Centered for Industry. Revised booklet describes properties and typical end uses of the company's line of plastics materials. 12 pages. *Plastics Div., Monsanto Chemical Co., Springfield 2, Mass.*

Flameproof molding compounds. Specifications, uses, and tabulated technical data on seven new flameproofed and heat-resistant diallyl phthalate molding compounds for electrical and electronic use. 4 pages. *Mesa Plastics Co., 12270 Nebraska Ave., Los Angeles 25, Calif.*

Acrylonitrile-butadiene-styrene. Mechanical, thermal, and electrical properties; impact strength; uses; and similar data for Cycolac ABS. 8 pages. *Marbon Chemical, Division of Borg-Warner, P. O. Box 68, Washington, W. Va.*

Testing equipment. Brochure describes 73 testers and other equipment made by the firm, including abrasion testers; biological and scientific equipment; flammability-ignition testers; production, control, and research equipment; thermal conductivity-dielectric units; and thickness, compression, and recovery gages. Catalog 59A. 16 pages. *Custom Scientific Instruments, Inc., 541 Devon St., Kearny, N. J.*

Marking machines. Describes practical methods and equipment for marking of all types of electrical and electronic products, including label legend marking, color banding, screen process printing, tape and label printing, wire and tube marking, etc. 12 pages. *Markem Machine Co., Keene 45, N. H.*

Indexing units. Drawings; tables of indexing positions and cams; results of accuracy tests; and dimensions of standard tooling and dial plates for indexing units, which are used in the plastics and other industries. 26 pages. *Standard Tool & Mfg. Co., 237 Laurel Ave., Kearny, N. J.*

Machine tools. Specifications, features, uses, etc., for a line of drill presses, grinders, cut-off machines, band saws, and belt and disc surfacers for the plastics and other industries. Catalog WT-50-9. 48 pages. *Walker-Turner Div., Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.*

Epoxy flooring materials. Properties, uses, advantages, and other data for Rezklad epoxy flooring materials, which can be applied to existing floors or concrete slab. Bulletin 3-4. 4 pages. *Atlas Mineral Products Co., Mertztown, Pa.*

Vinyl resins. Resin and compound properties, uses, etc., for a line of Marvinol general-purpose vinyl resins: VR-22, -23, -24, -25, and -26. 5 pages. *Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

Hydraulic presses. Specifications, uses, etc., for a line of hydraulic presses for compression and transfer molding and laminating. Catalog 88. 14 pages. *Atlas Hydraulics Div., Delaware Valley Mfg. Co., Inc., 3576 Ruth St., Philadelphia 34, Pa.*

Glycol-ether solvents. Physical properties, chemical derivatives, end-use possibilities, storage and handling, physiological properties, specification limits, test methods, etc., for Cellosolve and Carbitol glycol-ether solvents, which are miscible with most liquids, including resins. 40 pages. *Union Carbide Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Sucrose acetate isobutyrate. Typical properties, applications, solution viscosity, compatibility data, etc., for sucrose acetate isobutyrate which is used, among other things, as a modifying extender for **(To page 170)**

film-formers and extrudable plastics. 16 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

How to Work with Plexiglas. Gives information on machining, forming, finishing, and joining of Plexiglas sheets and other acrylic shapes. Includes over 60 illustrations. 20 pages. *Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.*

Dielectric Materials at Microwave Frequencies. Wall chart gives properties of dielectric materials at microwave frequencies over a wide range of dielectric constant and dissipation factors. 1 page. *Emerson & Cuming, Inc., Canton, Mass.*

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Urethane polymers. "Safety Precautions for Handling Thiokol's Urethane Polymers for Foam, Casting, and Coating Applications." Bulletin TT-1. 4 pages. *Chemical Div., Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.*

Linear polymers. "X-ray Diffraction by Assemblages of Line Scatterers with Application to Linear Polymers." 5 pages. *Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa.*

Laminating resins. Properties, room temperature setting data, uses, etc., for Epocast laminating resin. 4 pages. *Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif.*

Electronic industry catalog. "Electronic Engineers Master (EEM)" is a catalog and purchasing directory containing product information on 456 manufacturers, and incorporating the source material into three directories. Over 5000 tradenames are identified by manufacturer. A monthly supplement keeps EEM up-to-date. 1400 pages. Price: $10.00. *Tech Publishers, Inc., 60 Madison Ave., Hempstead, N. Y.*—**End**

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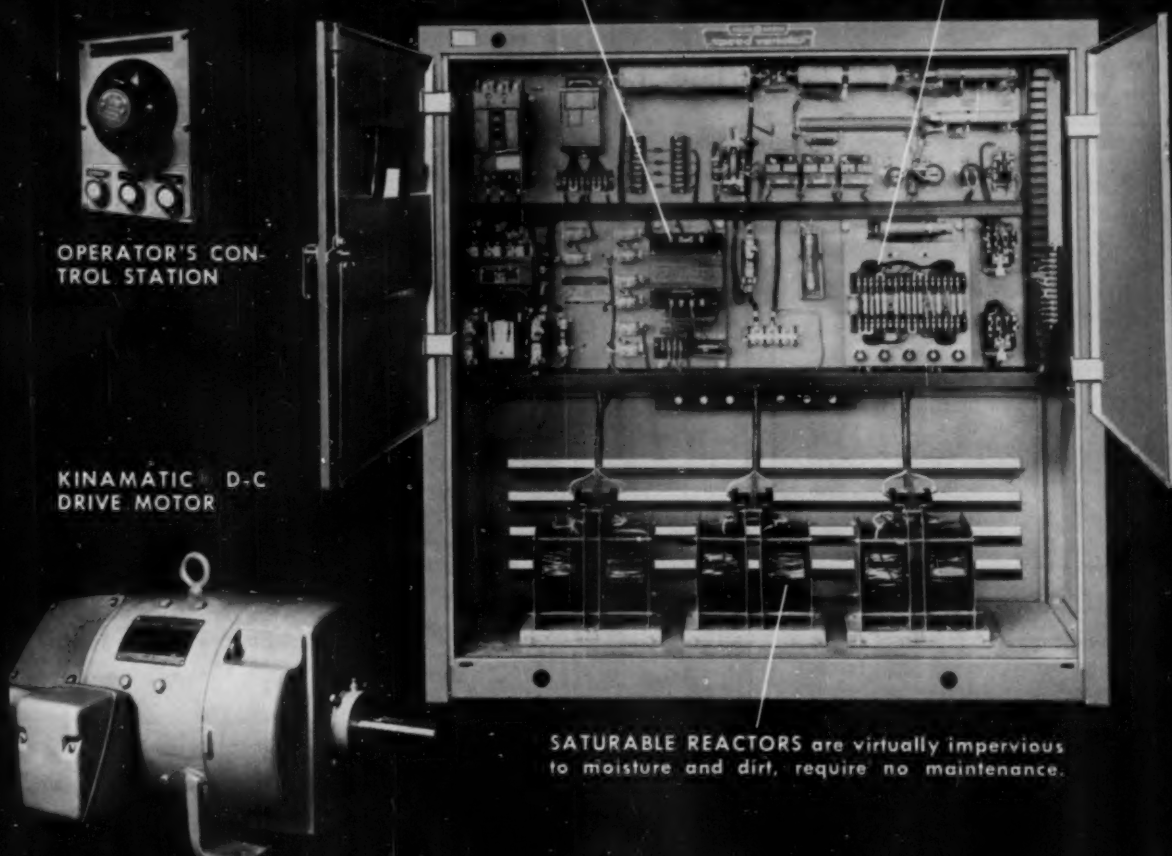

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THE PLASTICIZER MARKET IN REVIEW

By William J. Reid*

Recent publication by the U. S. Tariff Commission of its preliminary annual report on plasticizers provides an opportunity to review in detail the United States plasticizer market in 1958.

U. S. plasticizer consumption is estimated to have been 445 million lb. in 1958, a slight increase over 1957 demand. Tariff Commission indicates that 417 million lb. of plasticizers were produced in 1958. The difference between production (Tariff) and consumption (estimated) may be largely accounted for by industry-wide inventory reduction in early 1958, and, in part through difficulties encountered in collecting accurate production figures on as diverse an industry as plasticizers.

The published sales figure for 1958 was 355 million lb., 62 million lb. below production. This difference may be attributed primarily to captive use.

Vinyl plastics continue to consume the major share of U. S. plasticizer output. Approximately 310 million lb., or 70% of 1958 demand, were used in compounding with poly (vinyl chloride) and copolymer resins for various plastic end-use applications (Table I, p. 180.). This share has remained relatively constant in recent years. Estimated consumption in the United States in (To page 178)

*Assistant Manager, Market Research, Union Carbide Chemicals Co.

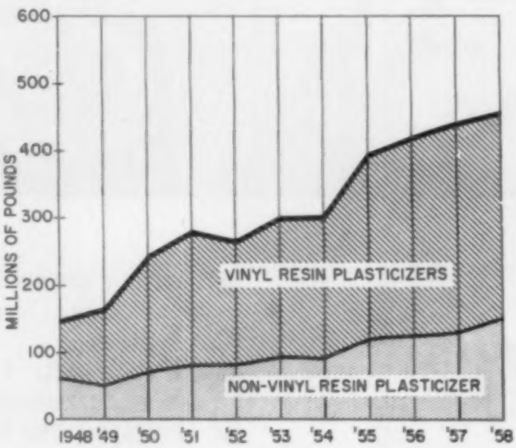


FIG. 1: Estimated consumption of plasticizers in the U. S. for 10-year period.

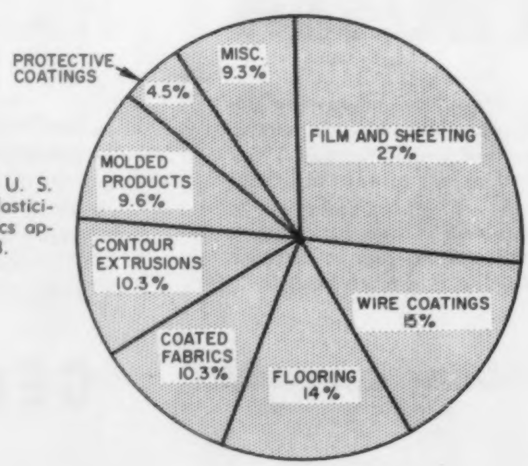
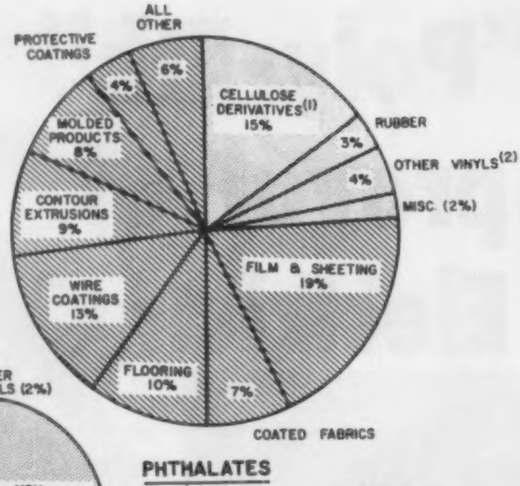


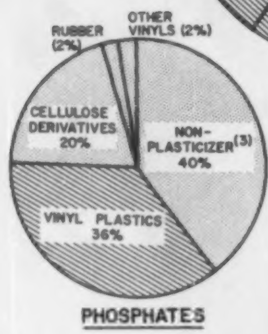
FIG. 2: Estimated U. S. consumption of plasticizers in vinyl plastics applications for 1958.

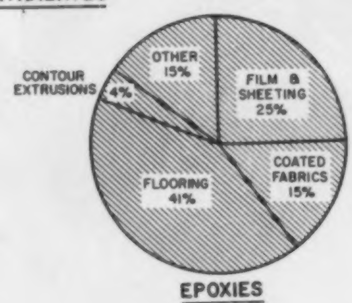
United States production and sales of plasticizers[a]

Material	Production 1954	1955	1956	1957	1958	Sales 1958
	1000 lb.	1000 lb.	1000 lb.	1000 lb.	1000 lb.	1000 lb.
GRAND TOTAL	**308,674**	**396,056**	**416,788**	**422,085**	**417,214**	**355,365**
PLASTICIZERS, CYCLIC						
Total	**227,618**	**296,294**	**315,343**	**329,176**	**312,225**	**265,102**
Phosphoric acid esters, total	—	—	—	54,536	—	—
Cresyl diphenyl phosphate	—	—	—	—	7,222	7,418
Tricresyl phosphate[b]	23,847	34,194	32,265	29,944	26,463	26,244
Triphenyl phosphate	6,426	8,632	8,318	8,991	8,023	—
Phthalic anhydride esters, **total**	**170,818**	**212,815**	**237,382**	**251,157**	**237,464**	**197,266**
Butyl decyl phthalate	—	1,036	3,869	4,582	—	—
Butyl octyl phthalate	—	—	—	—	10,573	11,544
Dibutyl phthalate	19,876	23,858	22,017	17,631	12,902	9,026
Dicapryl phthalate	5,832	—	3,667	—	—	10,694
Dicyclohexyl phthalate	—	—	—	5,944	6,771	3,447
Diethyl phthalate	15,999	15,799	18,661	18,281	14,454	10,098
Diisodecyl phthalate	—	8,968	17,038	24,431	23,372	14,499
Di(2-methoxyethyl)phthalate	2,098	3,005	3,247	2,388	2,702	2,150
Dimethyl phthalate	2,557	3,950	4,037	3,293	3,494	2,914
Dioctyl phthalates, **total**	**88,224**	**102,287**	**111,661**	**113,052**	**110,840**	**88,155**
Di(2-ethylhexyl) phthalate	54,067	71,640	80,632	73,568	76,729	56,079
Diiso-octyl & mixed octyl phthalates	34,157	30,647	31,029	39,484	34,111	32,076
Octyl decyl phthalate	10,060	13,102	11,269	13,319	10,293	9,105
All other	25,964	40,810	41,916	48,236	43,063	35,634
All other cyclic plasticizers[c]	26,735	40,653	37,378	39,084	33,053	34,174
PLASTICIZERS, ACYCLIC						
Total	**73,056**	**99,762**	**101,445**	**112,900**	**104,989**	**90,263**
Adipic acid esters, **total**	**7,037**	**10,592**	**8,504**	**8,975**	**9,439**	**6,544**
Di(2-ethylhexyl)adipate	2,710	2,651	1,128	1,828	1,731	1,296
Didecyl adipate	—	1,472	1,150	1,294	—	—
Diisobutyl adipate	—	—	—	359	—	—
Diisooctyl adipate	884	1,592	2,218	1,826	—	—
Dioctyl adipate	—	—	—	—	2,134	1,290
Octyl decyl adipate	—	—	—	—	1,137	784
All other	3,443	4,877	4,008	3,668	2,474	882
Azelaic acid esters	—	—	9,474	5,854	5,748	5,409
Dibutyl maleate	—	—	—	—	4,075	2,579
Glyceryl monoricinoleate	—	287	301	334	328	338
Lauric acid esters[d]	55	—	—	—	—	—
Oleic acid esters, **total**	**10,085**	**11,545**	**10,084**	**10,033**	**6,007**	**4,847**
Butyl oleate	—	1,999	1,858	2,006	1,179	346
Methyl oleate	—	811	693	817	—	—
All other	—	8,735	7,533	7,210	4,828	4,501
Palmitic acid esters	—	—	—	—	2,593	514
Phosphoric acid esters	6,122	10,412	6,565	10,221	7,327	5,768
Sebacic acid esters, **total**	**6,566**	**9,305**	**11,792**	**12,553**	**11,370**	**10,424**
Dibutyl sebacate	1,950	3,435	3,111	3,595	—	—
All other	4,616	5,870	8,591	8,958	—	—
Stearic acid esters, **total**	**6,469**	**9,628**	**10,506**	**9,903**	**5,648**	**4,751**
n-Butyl stearate	3,647	6,368	7,085	5,829	2,426	2,030
All other	2,822	3,260	3,501	4,011	3,222	2,721
Triethylene glycol di(caprylate-caprate)	—	2,031	1,440	2,315	1,659	1,633
All other acyclic plasticizers[e]	36,722	45,962	42,789	52,721	50,795	47,456

[a] All figures are from U. S. Tariff Commission reports.
[b] Includes material produced for use as motor fuel additives.
[c] Includes data for synthetic camphor, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.
[d] Tariff Commission through 1954 listed these separately; in 1955, they were included in "All other acyclic plasticizers."
[e] Includes data for citric and acetylcitric, tartaric and ricinoleic acid esters, and for butyl myristate; glyceryl and glycol esters of certain fatty acids, glyceryl tripropionate, complex polymeric materials, and other acyclic plasticizers.







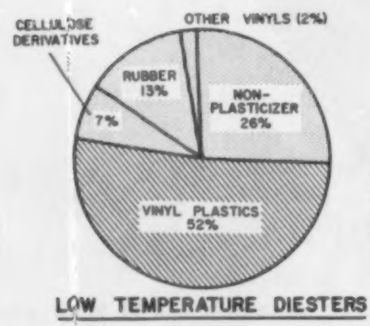
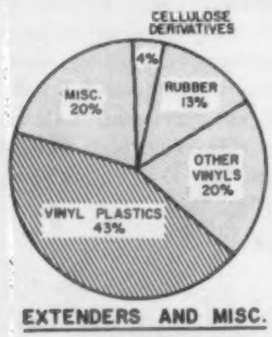
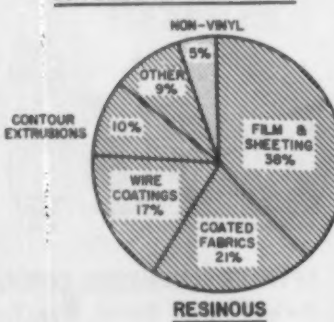


FIG. 3: Six "pie" charts show the consumption of plasticizers by major end-use markets in the United States in 1958. Estimates were reported by the U. S. Tariff Commission.





vinyl plastics by end-use market is shown in Fig. 2, p. 174.

The U. S. plasticizer market has grown at the average rate of 11% per year during the past 10-year period 1948-1958 (Fig. 1, p. 174). This strong growth record is largely due to the burgeoning growth of vinyl plastics in the late 1940's and the early 1950's. In recent years, however, the growth rate of both vinyls and plasticizers has been notably reduced as markets have matured.

The plasticizer industry generally classifies plasticizers into six major groups; phthalates, phosphates, resinous (or polymeric plasticizers), low-temperature diesters, epoxies, extenders, and miscellaneous. Estimated U.S. consumption by major types is shown in Table II, p. 180, and by major end-use market as indicated in Fig. 3, above. The U. S. Tariff Commission divides plasticizers into two principal groups, cyclic and acyclic plasticizers. Tariff Commission figures allow the grouping of phthalates, phosphates, and low-temperature diesters; however, resinous, epoxy, and miscellaneous plasticizers may be obtained only through inspection of published Tariff data and analysis of end-use markets.

Cyclic plasticizers

Phthalic anhydride esters remain the industry's major class of plasticizers. Tariff reports a 1958 U. S. production of 237 million pounds. Consumption is estimated to have been somewhat higher, 248 million lb., 56% of total U. S. plasticizer consumption. This percentage figure has remained essentially unchanged during the past few years. The largest portion of phthalate plasticizers, estimated by the Commission at 192 million lb., were consumed in vinyl plastics.

Octyl phthalates continue to be the most important members of the commercial phthalate family, particularly in the vinyl plastics industry. In 1958, di(2-ethylhexyl) phthalate (DOP) retained its long-established position as the industry's leading plasticizer. This product has become a basic building block in vinyl formulations because it offers the best balance of performance and price. The Tariff Commission indicates that 1958 DOP production increased slightly over 1957.

Diisooctyl phthalate consumption remained steady at around 40 million pounds. Tariff indicates that production declined slightly from 1957.

Diisodecyl phthalate has shown no growth for the first time since its introduction as a commercial plasticizer in 1953. The principal reason for this lack of growth in 1958 stems from the depressed condition of the wire and cable industry, suffering from a decline in construction activity and a weak copper market. Generally, good performance, including low volatility and good electrical properties, make DIDP well suited for wire coatings. Other uses for DIDP which aided in holding consumption at the 20-25 million lb. level include vinyl film, sheeting,

Table I: 1958 plasticizer consumption by end use

	Million lb.	*% of total*
Vinyl plastics	310	70.0
Cellulose derivatives	56	12.5
Rubber	22	5.0
All other vinyls	21	4.5
Miscellaneous and non-plasticizer uses	36	8.0
Total	445	100.0

and a variety of applications for vinyl dispersions in which the low solvation rate of DIDP is desirable for maintaining proper flow characteristics and preventing premature gelation.

Reduced activity in the wire and cable industry is also believed to have accounted for the decline in both production and consumption of octyl decyl phthalate, despite the general availability of n-octyl n-decyl alcohols in 1958.

Dicapryl phthalate consumption is estimated to have been 10 million lb. in 1958. Vinyl film and sheeting are major consumers of dicapryl phthalate. The product has also found considerable use in many vinyl dispersion applications in which the low initial viscosity of dicapryl phthalate is a desirable feature.

Other phthalates of particular interest in an expanding vinyl flooring market are butyl benzyl phthalate, butyl octyl phthalate, and butyl decyl phthalate. The ability of these plasticizers to wet resin and filler is a valuable processing aid in the manufacture of such products as vinyl asbestos tile. Butyl benzyl phthalate has reportedly found a growing market as a plasticizer for acrylic automotive lacquer, where it has replaced dibutyl phthalate that was formerly used in older nitrocellulose-based coatings.

Among non-vinyl plasticizers dibutyl phthalate has experienced a sharp decline in production attributed primarily to a loss of the automotive lacquer market. Dicyclohexyl phthalate production increased by almost a million lb. as cellophane markets continue to grow. Diethyl phthalate production declined as demand for cellulose derivative plastics slackened. Production of all other phthalates did not rise appreciably over 1957.

Phosphoric acid esters are used as plasticizers, oil and gas additives, and functional fluids. U. S. consumption of cyclic phosphates amounted to 52 million lb., of which an estimated 33 million lb. were used as plasticizers. Tricresyl phosphate is well established in the industry as a permanent, flame retardant plasticizer for vinyl and cellulose derivatives. Cresyl diphenyl phosphate is often used in preference to TCP because it is slightly more efficient, imparts better flexibility, and is more light stable. Alkyl aryl phosphates, not accounted for in the preliminary Tariff figures under cyclic phosphates, are flame retardant plasticizers, which, compared to TCP, have improved efficiency and low-temperature properties, and in addition are approved non-toxic plasticizers. The last remaining cyclic phosphate, triphenyl phosphate, is used as a flame-retardant plasticizer for cellulose acetate.

Other miscellaneous cyclic plasticizers include camphor, sulfonamide plasticizers, tetrahydrofurfural oleate, chlorinated aromatics, phthalyl glycolates, and a variety of aromatic extenders.

Acyclic plasticizers

Adipic acid esters are widely used to impart low-temperature flexibility to vinyls, rubber, and other resins. Di(2-ethylhexyl) adipate and diisooctyl adipate are the two most popular adipate diesters. Diisodecyl adipate and n-octyl n-decyl adipate are used

Table II: 1958 plasticizer consumption by chemical type

	Million lb.	*% of total*
Phthalates	248.0	56.0
Phosphates	56.0	12.5
Resinous	29.0	6.5
Low temperature diesters	30.5	7.0
Epoxies	27.0	6.0
Miscellaneous and extenders	54.5	12.0
Total	445.0	100.0

in applications requiring low plasticizer volatility.

Azelaic acid esters are used as low-temperature plasticizers for vinyls and as a jet aircraft lubricant base fluid. Reported production of azelate diesters remained relatively close to the 1957 level.

Acyclic phosphoric acid esters include tri(2-ethylhexyl), tributyl, triisobutyl, tripropyl, trichlorethyl, tributoxyethyl, and triethyl phosphates. Production declined somewhat from the 1957 level of 10 million lb., as the industry is believed to have worked off high inventories of acyclic phosphates accumulated in 1957.

Sebacic acid esters are used as plasticizers and jet aircraft lubricant base fluids. Production in 1958 was reported as 11 million pounds. The major part of this output was consumed in jet lubricants. Plasticizer applications themselves consumed a little less than 5 million pounds.

Oleic acid esters are used primarily as plasticizers for rubber. Production, however, reportedly declined from the 1957 level of 10 million pounds.

Stearic acid esters are used as plasticizers and lubricants for rubber, cellulose derivatives, and in smaller amounts for other resins. Tariff reports that production declined from the 1957 level of 10 million pounds.

Epoxy plasticizers, which are believed to be partially included in the rather substantial Tariff designation, "all other acyclic plasticizers," are of two major types: epoxidized oils and alkyl epoxy stearates. Total epoxy plasticizer consumption in 1958 is estimated to have been 27 million lb., more than half of which was epoxidized soybean oil.

Resinous plasticizers, another sizable component of the "all other" category, include adipate, azelate, and sebacate polyesters as well as dipentaerythritol derivatives. Consumption of all types of resinous plasticizers in 1958 was estimated to have been in the neighborhood of 29 million pounds.

Remaining acyclic plasticizers include citrates, tartrates, ricenoleates, palmitates, esters of triethylene glycol, esters of fatty acids, and a variety of specialty plasticizers and extenders.—**End**

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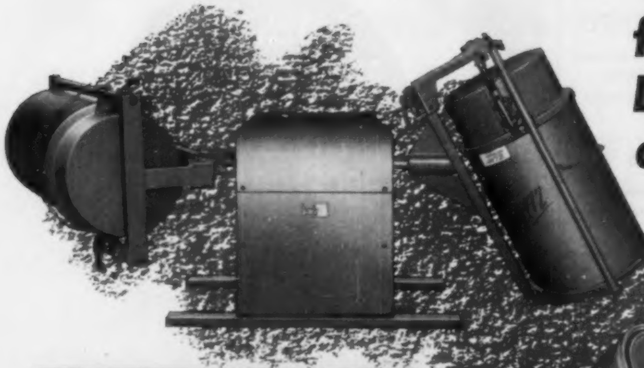

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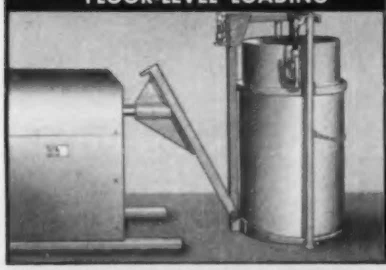

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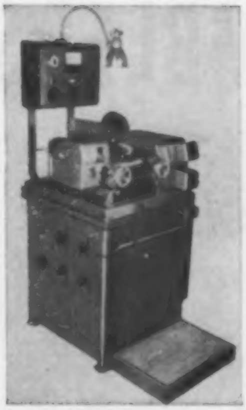

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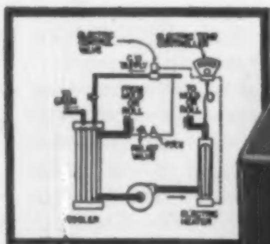

▲ Schematic diagram of control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits. Model MC-3 has three complete circuits.

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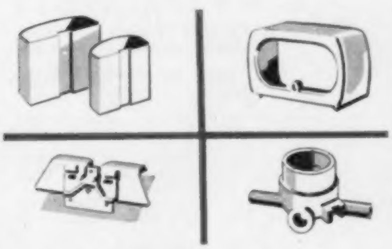
Thermaflow® Tips

News about high-strength molding compounds

Atlas Powder Company, Wilmington 99, Delaware
In Canada: Atlas Powder Company, Canada, Ltd., Brantford, Ont.

New Thermaflow 105 saves 20% over other high-strength plastics

If you've been interested in using high-strength plastics in products now made of metal or conventional plastics—but found the price tag too steep . . . here's news. New Thermaflow 105 reinforced polyester premix gives you a balance of strength, moldability, surface finish, chemical and electrical properties—at a cost about 20% lower than other high-strength compounds. It's the best buy yet in terms of strength per dollar.



An "idea" material

This new combination of performance and price opens up endless new design possibilities. Use it for new quality and economy in TV and radio cabinets, air conditioner housings, appliance parts, instrument cases, tubes, buckets, panels, tanks. You name it . . . we'll help you do it.

Take a look at the characteristics listed here. Remember—you'll get maximum benefits when you design to utilize its high-strength, corrosion resistance, and consistently high quality to the utmost. It's easy to use, too . . . pulls apart readily to load in molds, and has long stability in storage.

MOLDED PROPERTIES

Specific gravity	1.87
Flexural strength, psi	
*ASTM bar	20,000
**Cut specimen	16,000
Flexural modulus (psi x 10^6)	1.6
Izod impact-notched, ft./lbs./in. notch	
*ASTM bar	12.0
**Cut specimen	4.5
Compressive strength, psi	18,000
Heat distortion point, 264 psi	>450° F.
Barcol hardness	65
Water absorption, %	
24 hours @ 23° C.	0.14%
24 hours @ 100° C.	0.75%

*ASTM bar—Test results achieved with a sample molded under ideal laboratory conditions to achieve maximum strength.

**Cut specimen—Test results achieved on a number of samples cut from molded parts at random direction to any possible glass alignment. Results reported are the average of several tests.

NOTE: Common practice reports test results in terms of the maximum values available under ideal conditions "ASTM bar" figures are listed here to permit comparison of Thermaflow 105 with other similarly reported materials.

ELECTRICAL PROPERTIES

Arc resistance, sec.	130 sec.
Dielectric strength (1/8" thick)	
v/mil short time	230 v/m
step by step	210 v/m
Dielectric constant (1 mc.)	5.05
Dissipation factor (1 mc.)	0.009

STRENGTH RETENTION

	Flexural Strength, psi	Flexural Modulus x 10^6	Appearance
Original sample	16,000	1.58	—
24 hours	After Test	After Test	
H_2O @ 100° C.	13,400	1.21	excellent
24 hours 10% boiling NaOH	13,800	1.09	good
24 hours 10% boiling HCl	10,500	0.87	surface good—pigment bleached white

Price Schedule (f.o.b. Wilmington; Net 30 days)

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1 carton — (80 lbs.)	— $ .64/lb.
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120 cartons — (9,600 lbs.)	— .41/lb.
252 cartons — (20,160 lbs.)	— .40/lb.
less than 1 carton	— 1.00/lb.

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Plastics Digest

(From pp. 52, 54)

The effect of α-naphthylamine, an antioxidant, on the change of the dielectric loss of PE during aging was studied. The photo-oxidation was carried out by exposure to ultraviolet radiation from a mercury quartz lamp and dielectric measurements were made at 10 kilocycles per second over a temperature range of −75 to +100° C. The dielectric measurement is a sensitive method of estimating the degree of polarity of oxidation products and α-naphthylamine was an effective oxidation inhibitor for PE.

Nuclear resonance studies of polymer chain flexibility. W. P. Slichter. SPE J. *15*, 303-09 (Apr. 1959). Recent studies of polymer behavior through the application of nuclear magnetic resonance (NMR) methods are summarized. Some of the theory of nuclear magnetism is presented. The use of NMR methods often yields information which might be impossible to obtain by any other means. The effects of the intermolecular forces and of the molecular shape upon chain flexibility, and the effects of chain stiffness were selected as examples of useful fields of investigation in polymer science.

Testing

Quantitative determination of organically bound metals in polyvinyl chloride. E. Schroeder and S. Malz. Plaste u. Kautschuk 5, 416-17 (1958). A small amount of a metal salt such as cadmium stearate or lead chloride is usually added to polyvinyl chloride as a stabilizer. For a quantitative determination of the metal present, the metal salt is oxidized to its ionic form to give metal nitrates which, after extraction, can be determined polarographically.

Determination of resin content in phenolic molding powders. H. Wallhäusser. Kunststoffe 49, 171-73 (Apr. 1959). The determination of resin content by means of extraction with acetone has until now been possible only in the case of Novolak compounds. This method fails to give satisfactory results with Resol compounds. If, however, cyclohexanone is used as extractant and the method is suitably modified, then it may be applied to both types of compound.

Effect of processing conditions on mechanical properties of injection molded polystyrene standard test pieces. R. Budesheim and W. Knappe. Kunststoffe 49, 257-64 (June 1959). Standard test pieces were injection molded on a multi-cavity mold with factors such as cylinder temperature, external injection pressure, and dwell time being systematically varied. It was found that the effect on flexural strength was statistically constant and reproducible, and also that it depends not only on processing conditions, but also on the position of the test piece in the tool. The values obtained are found in the region 917-1177 kg./cm^2. Values for impact strength are not easily reproducible and may range from 8.7 to 24.5 cm.-kg./cm^2. Mechanical strength, orientation, and internal stress relationships are considered.

Chemistry

Tricky dehydration opens monomer route. C. S. Cronan. Chem. Eng. 66, 42-44 (June 1, 1959). Previous attempts to produce acrylonitrile monomer from acetaldehyde failed because dehydration of lactonitrile to acrylonitrile at high temperature also decomposed the lactonitrile and ruined the yield. This decomposition is prevented by dehydrating the lactonitrile instantaneously in the presence of concentrated phosphoric acid. The process is described with the aid of a flow sheet and compared with processes based on ethylene oxide or acetylene.

Publishers' addresses

Adhesives Age: Palmerton Publishing Co., Inc., 101 W. 31st St., New York 1, N. Y.

Bulletin Chemical Society of Japan: No. 5-1 Kandafurugadai, Chiyoda-Ku, Tokyo, Japan.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington, D. C.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal Phys. Soc. of Japan: Tokyo University, Mopofugi-Machi, Bunkyo-Ku, Tokyo, Japan.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Strasse 7, Munich 27, Germany.

Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Mechanical Engineering: American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Nature: Macmillan & Co., Ltd., St. Martin's St., London WC2, England.

Nucleonics: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Plaste u. Kautschuk: VEB Verlag Technik, Unter den Linden 12, Berlin NW 7, Germany.

Poliplasti: Via Mantegna, 6, Milan, Italy.

Revue Generale du Caoutchouc: 42, Rue Scheffer, Paris XVIe, France.

Rubber and Plastics Age: Rubber and Technical Press, Ltd., Gaywood House, Great Peter St., London SW1, England.

SPE Journal: Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

TAPPI: Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York, N. Y.—End

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CONTRACT MANUFACTURING. Illustrated 4-page brochure describes designing and engineering services and manufacturing facilities for components or products of metal or plastic. Short or long runs. Wide variety of fabricating techniques. Atti Engineering Corp. (J-901)

SYNTHETIC RUBBERS. Illustrated 24-page booklet reports on the commercial histories of two elastomers. Describes characteristics, properties and applications. Offers engineering assistance to apply them to new products. E. I. du Pont de Nemours and Co., Inc. (J-902)

WIRE-DIAMETER CONTROL. 4-page brochure discusses the value of automatic diameter control in the production of insulated electric wire and cable, and compares the continuous contact and non-contact methods in terms of capability, limitation and cost. Daystrom-Weston (J-903)

ELECTRIC STEAM GENERATOR. 8-page brochure describes and gives specifications for an electric steam generator in two models—0 to 100 psi and 100 to 250 psi. Wiring diagram. Automatic Steam Products Corp. (J-904)

CUSTOM MOLDING. Illustrated 12-page brochure describes the facilities and services of a custom plastics molder. Injection molding, vacuum forming, die forming, imprinting, laminating, embossing, etc. Emeloid Co. (J-905)

EXTRUDING FROM STOCK DIES. 4-page brochure shows in profile several dozen shapes available from a stock of standard dies. Lists the plastic compounds kept in stock. Conneaut Rubber & Plastics Co. (J-906)

AEROSOL ABHESIVE. 20-page handbook describes an abhesive applied by aerosol spray, discusses its role in plastic injection molding, and outlines its many other applications. *(Note: In a review for this handbook, which appeared in the August issue of Modern Plastics, the world "adhesive" was used erroneously in place of "abhesive".)* Price-Driscoll Corp. (J-907)

PLASTICS, CHEMICALS CATALOG. 16-page catalog and price list of a warehouse distributor includes fiber glass fabrics and fibers, polyester and epoxy resins and catalysts, parting agents, pigments, etc. Property tables, application data. Cadillac Plastic & Chemical Co. (J-908)

ROTATIONAL MOLDING DATA. Illustrated technical data sheet discusses rotational molding of plastisols and describes how the inblending of two varieties of Pliovic with compounding ingredients furthers adaptation to the process. Suggests two starting formulations. Goodyear Tire & Rubber Co. (J-909)

CORE CUTTER. Illustrated bulletin sheet describes a core cutter for paper cores from 3 to 6 inches I.D. Can cut to the center of a 90-inch long core. Outboard support bracket allows longer cuts. John Dusenbery Co., Inc. (J-910)

STABILIZATION OF POLYVINYL CHLORIDE. 24-page booklet describes a line of stabilizers including barium-cadmium, zinc, barium-cadmium soaps, chelators and other metallic types. Discusses choosing a stabilizer system and specific applications. Specifications. Argus Chemical Corp. (J-911)

POLYPROPYLENE. 8-page brochure gives technical information on polypropylene, a new crystalline polymer of isotactic structure. Tables of physical properties, effects of reagents and of solvents. Processing data. Also article-reprints on polypropylene and on Italian chemical industry. Montecatini Soc. Gen. (J-912)

POLYVINYL DISPERSION. Illustrated 12-page brochure gives general information on a specially formulated, high molecular weight, polyvinyl dispersion which is a 100% non-volatile liquid not requiring high pressure in converting to solid. Chemical Products Corp. (J-913)

MOLD TEMPERATURE CONTROL. Illustrated 6-page brochure describes a line of mold temperature control equipment, giving information on selection of pump and heater capacities. Also, reprint of technical paper and folio of answers to typical questions. Industrial Manufacturing Corp. (J-914)

HYDRAULIC PRESSES. Illustrated 4-page brochure describes hydraulic presses for molding in 50 & 190 ton capacities, for molding and laminating in 756 & 8300 ton, for polishing and laminating in 880 ton, for embossing in 500 ton and for lab use in 50 ton. R. D. Wood Co. (J-915)

EXTRUDERS. Illustrated 8-page brochure describes a new line of extruders in 2½, 3½, 4½, 6 and 8 inch bore sizes, with L/D ratios of 15.5:1 or 20:1. Davis-Standard (J-916)

INJECTION MOLDERS. An illustrated 4-page brochure on each of two injection machines: up to 6 ozs. (or 9 ozs. using double feed) of polystyrene or 23.4 cu. in. of any other granular thermoplastic, and up to 24 ozs. (or 32 ozs.) or 82.5 cu. in. Specifications, drawings. Lester-Phoenix, Inc. (J-917)

DIAMOND COMPOUNDS. Illustrated 4-page brochure describes a self-lubricating diamond compound and its application to lapping and polishing dies and molds. Hyprez Div., Engis Equipment Co. (J-918)

ARTICLES ON MOLDS. Two illustrated 8-page brochures. One is a reprint of an article on solving problems connected with very large molds; the other, of an article on reducing costs, through standardization, in using unscrewing molds. Newark Die Co. (J-919)

PHENOLICS. Two 4-page bulletins. One describes the advantages of phenolic compounds and suggests compounds for various typical uses. Other offers suggestions for obtaining automotive work and recommends compounds for various parts and applications. Fiberite Corp. (J-920)

PRESSES, PREFORMERS. Illustrated 16-page brochure describes and gives specifications for a line of hydraulic molding presses in 10 to 400 ton capacities and preformers in 30, 50, 70 and 125 ton capacities. Logan Hydraulics, Inc. (J-921)

REINFORCED MOLDING COMPOUNDS. Catalog of a line of reinforced molding compounds gives descriptions, specifications, recommended molding conditions, storage and handling tips and suggestions on die selection and design. Atlas Powder Co. (J-922)

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SEALING EQUIPMENT. Illustrated data sheets describe a guillotine press with plate size varying from 4 x 36 in. to 40 x 96 in., a rotary sealer with speeds up to 50 ft/min., a bar press with plate size 4 x 24 in. to 12 x 60 in. and "C" presses from 16 x 24 in. to 48 x 96 in. Mayflower Electronic Devices, Inc. (J-923)

ACRYLONITRILE REACTIONS. Booklet describes briefly acrylonitrile reactions under these headings: hydroxyls, amines, halogenation, hydration & hydolysis, formaldehyde, sulfhydryls, reduction, Diels-Alder, amides, olefin, aldehydes & ketones, polymerization. Formulae. American Cyanamid Co. (J-924)

PROCESS HEATER. Illustrated 4-page brochure describes a process heater in models rated from 25,000 to 800,000 BTU. Operates on 220, 440 or 550 volt, 60 cycle, 3 phase power supply. Processed glycol liquid, in two types. Pantex Manufacturing Corp. (J-925)

PLASTIC DIES, PATTERNS, ETC. Illustrated 7-page bulletin describes a method of making dies, patterns, core boxes, dryer patterns, etc. in much less time than by traditional methods. Involves a preform which is toughened by impregnation through capillary action. United States Gypsum (J-926)

MIXERS. Illustrated 4-page brochure describes a double-arm plastics mixer with split-level bowl, in capacities from 150 to 900 gals., a spiral ribbon mixer in sizes from 1 to 500 cu. ft. and a line of planetary action vertical mixers. Read Standard (J-927)

HEATING & COOLING UNIT. Illustrated data sheet describes a heating and cooling unit for injection molds, cylinders, rolls and drums. Recirculating capacity up to 25 gpm. Working temperatures 50 to 250° or 100 to 300°. Sarco Co. (J-928)

PORTABLE HARDNESS TESTER. Illustrated bulletin sheet describes a hand-held hardness tester weighing 12 ozs. with instant-reading dial. Gives conversion curve comparing readings for very soft materials with Rockwell, Brinell & Vickers numbers. Barber-Colman Co. (J-929)

VACUUM FORMER; PREHEATER-DRYER. Data sheets describe a vacuum forming machine with draw depth of 6 in. and mold area of 18 x 18 in. with foot operated drape mechanism, and a combination hopper-type preheater-dryer in two sizes, bin capacities 5 or 10 cu. ft. Thermomat Co., Inc. (J-930)

EXTRUSION & MOLDING COMPOUNDS. Illustrated 4-page brochure lists a line of vinyl extrusion and molding compounds, custom compound types and color concentrates. Outlines laboratory and plant facilities. Blane Corp. (J-931)

REINFORCED PLASTIC MOLDINGS. Illustrated 8-page booklet describes a reinforced molding plastic and several finished items typifying the molding service offered. Cincinnati Milling & Grinding Machines, Inc. (J-932)

HYDRITE KAOLINITES. Illustrated 6-page brochure gives general, chemical colloidal and physical properties of a line of hydrite kaolinites and describes typical uses in adhesives, inks, paints and plastics. Georgia Kaolin Co. (J-933)

INJECTION MOLDING MACHINES. Illustrated 4-page brochure describes a hand operated injection machine of 10 gram (.39 cu. in.) capacity and a power operated 15 gram (.6 cu. in.) model. Specifications. Dowding & Doll, Ltd. (J-934)

AREA-WEIGHT CONTROL SYSTEM. Illustrated 8-page brochure describes an area-weight control system for rubber, plastics and resin impregnation process, and its advantages as shown by actual installations. Industrial Nucleonics (J-935)

SLITTERS, PRESSES. Illustrated 4-page brochure describes in several models, handling widths from 24 to 125 in. and a line of flexographic presses, listing 14 models and their plate-types, inks, widths, colors and speeds. Kidder Press Co. (J-936)

FLOW RATE TRANSMITTERS. Illustrated 12-page brochure describes a line of flow indicators, pneumatic and electrical transmitters and integrators. Tables of capacities. Brooks Rotameter Co. (J-937)

SPRAY-ON VINYL COATING. Illustrated 4-page brochure describes a system for spraying a leather-textured vinyl coating on metal products. Wide range of colors. Metal & Thermit Corp. (J-938)

VINYL RESINS. File folders of technical data sheets describes physical properties, recommended uses and applications for a line of vinylchloride and vinylacetate resins in a wide range of molecular weights. J. P. Frank Chemical Co. (J-939)

VINYL RESINS & COMPOUNDS. Illustrated 4-page brochure describes this company's new copolymers, paste resins, U.L.-approved resins and cold blend resins. Lists specific viscosities, applications and advantages. Diamond Alkali Co. (J-940)

INJECTION MACHINE NOZZLES. 56-page illustrated catalog describes this company's stock replacement and special-purpose injection machine nozzles. Gives prices and tells how to measure for special nozzles. Injection Molders Supply Co. (J-941)

ELECTRIC HEATERS. Illustrated booklet presents 25 case studies describing the uses and advantages of "Chromalof" strip, ring, tubular and cartridge heating elements in plastics processing. Edwin L. Wiegand Co. (J-942)

PVC RESINS. Comprehensive 56-page manual gives details on company's line of PVC resins, accompanied by extensive data on plasticizing, stabilizing, coloring and compounding. Includes much processing information and detailed explanation of test methods. General Tire & Rubber Co. (J-943)

INJECTION PRESSES. Illustrated data sheets give detailed specifications and describe operating features of a 2-, 3- and 4-oz. automatic injection press with dry run cycling speeds ranging from 450 to 1,300 per hr. Moslo Machine Co. (J-944)

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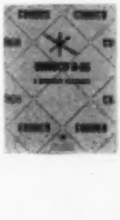

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Plastics Patents

(*From page 56*)

J. B. Dickey and T. E. Stanin (to (Eastman Kodak). 2,891,928.

Polyesters of a glycol, a dicarboxylic acid, and an amine acid. J. R. Caldwell and R. Gilkey (to Eastman Kodak). 2,891,929-30.

Calcium polyacrylate (to Monsanto). 2,891,931.

Polymers of acrylyl dicyandiamides. E. M. Hankins (to Rohm & Haas). 2,891,932.

Copolymer of difuluorovinyl chloride and vinyl acetate. J. E. Olin (to Pennsalt). 2,891,934.

High-density polyethylene. J. E. Guillet and H. W. Coover, Jr. (to Eastman Kodak). 2,891,936.

Polymerization of unsaturated hydrocarbons. H. W. B. Reed and H. G. Lawley (to Imperial Chemical). 2,-891,937.

U. S. Pats., June 30, 1959

Photopolymerizable composition. E. L. Martin (to Du Pont). 2,892,716.

Linear copolyesters. J. I. Dye (to Du Pont). 2,892,747.

Nitrile methylol phosphorus polymer. W. A. Reeves and J. D. Guthrie (to U. S.). 2,892,803.

Epoxy resin-plastisol composition. J. H. Shafer (to General Electric). 2,892,808.

Epoxy resins. W. E. St. Clair (to Koppers). 2,892,809.

Aminotriazine-formaldehyde resins. O. Albrecht (to Ciba). 2,892,810.

Furane resin. E. P. Irany (to Norton). 2,892,811.

Polyesters. C. H. Helbing (to Pittsburgh Plate Glass). 2,892,812-3.

Polypinates. W. T. Koch, M. A. Lytton, and E. A. Wielicki (to American Viscose). 2,892,814.

Polyethylene terephthalate. P. H. Hobson (to Chemstrand). 2,892,815.

Copolyamides from alpha-amino acids. G. E. Ham (to Chemstrand). 2,892,817.

Acrylate copolymers. R. H. Gray and V. J. Webers (to Du Pont). 2,892,822.

Water-soluble polyacrylamides. F. E. Boettner and W. D. Niederhauser (to Rohm & Haas). 2,892,823-5.

Trifluoropentadiene copolymers. A. N. Bolstad and J. M. Hoyt (to Minnesota Mining). 2,892,824.—**End**

Distributors

(From pp. 81-85)

veyor chain, to act as a cushion between the stainless steel chain and the U-channel in which it moved. The bottling firm adopted his suggestion and, at last reports, no replacements of any kind have been made.

PE "tents" for knitting machines: During vacation periods, a New Jersey knitting mill generally shut down its entire plant, using a covering of kraft paper to shield the delicate needle beds against moisture damage. On one occasion, heavy rains and a leaky roof poured water over the paper, disintegrating it and "freezing" the needle beds. The beds had to be removed from each machine and sent back to the factory for costly reconditioning. Expensive downtime swelled the losses. A distributor salesman, on a "doorbell-ringing" mission, heard about the problem and suggested that his firm fabricate polyethylene film tents to cover each machine. This eliminated the difficulty.

Corrosion-resistant hoods: A large Eastern chemical company had trouble with hoods that were exposed to corrosive gases formed in the manufacture of one of its products. Aluminum hoods were tried, but failed. Transite hoods worked for a while, then began to disintegrate. A plastics distributor salesman told the firm's purchasing agent about a new fire-retardant polyester formulated by another chemical firm he called upon, suggesting that the two should get together. Result: four hoods were made using the new material; after almost a year of rugged service, they showed no sign of deterioration.

Streamlining operation

Under the stimulus of competition, plastics distributors are constantly improving their services to customers. Each time basic manufacturers raise their mill minimums—the size of order that can be handled direct by the factory—distributors must step up their warehousing, stocking, packaging, and shipping facilities to keep pace. At least one major distributor plans to install, in the near future, a streamlined new inven-

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Chicago 80, Illinois

tory system based on punch cards data processing.

Some of the larger distributors have extensive facilities for producing their own line of basic plastic shapes or fabricating materials to meet customer requirements. One company, whose annual sales have increased some 8000% since its founding in 1946, recently completed a new plant which is equipped to produce a variety of cast acrylic rods, tubes, blocks, and extruded shapes. Acrylic rods and tubes are made under a Du Pont license arrangement. Several other materials, including Teflon, are also handled.

Another major plastics distributor maintains a separate division which provides a complete custom service for precision fabrication of thermoplastic and thermosetting materials. Parts, assemblies, and finished products are produced to exact blueprint specifications at this plant. Another prominent distributor with outlets in several cities is set up to fabricate electrical insulators and other types of parts on a volume basis from practically any plastic. There is a growing awareness among basic suppliers of plastic rods, sheets, tubes, and other semi-fabricated materials of the important role plastics distributors now play in the successful conduct of their industry services. Rohm & Haas Co., a major supplier of cast acrylic sheeting, for example, about a year ago set up a system of authorized Plexiglas dealers.

"The growth of the plastics industry over the past few years has been very large," says D. C. Kelly of the Rohm & Haas Plastics Department. "Plastic materials are being used more widely. Most all phases of our economy now put various plastic materials to use. Therefore, the distribution of plastic materials has become an increasingly important problem. . . .

"We currently have 69 authorized Plexiglas dealers in the United States. Most are located in metropolitan centers since the major potential for our material lies in the industrial markets. . . . A considerable amount of our total Plexiglas sheet business is now handled through our authorized dealers. . . ."

Owens-Corning Fiberglas Corp. currently has 16 distributors of its reinforcing products, operating in 24 major trading areas. These distributors, dealing mainly with the less-than-truckload buyer, offer a complete "package" of materials necessary to manufacture glass-reinforced plastic parts: reinforcing mats, rovings, chopped strand, milled fibers, surfacing mats, glass fabrics, polyester and epoxy resins, parting agents, pigments, catalysts, fillers, and films.

"With the hundreds of companies coming into the manufacture of fibrous glass-reinforced plastics items, our branch salesmen could not give each customer the amount of time they felt was necessary," said G. M. Irvine of Owens-Corning. "We elected to use distributors to handle the less-than-truckload business. . . ."

Ed. note: Space does not permit listing of all distributors. For full compilation, see *Modern Plastics Encyclopedia Issue for 1960,* p. 1160.—**End**

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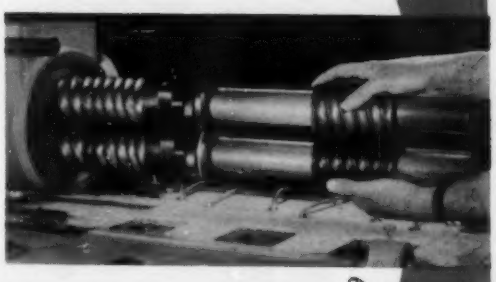

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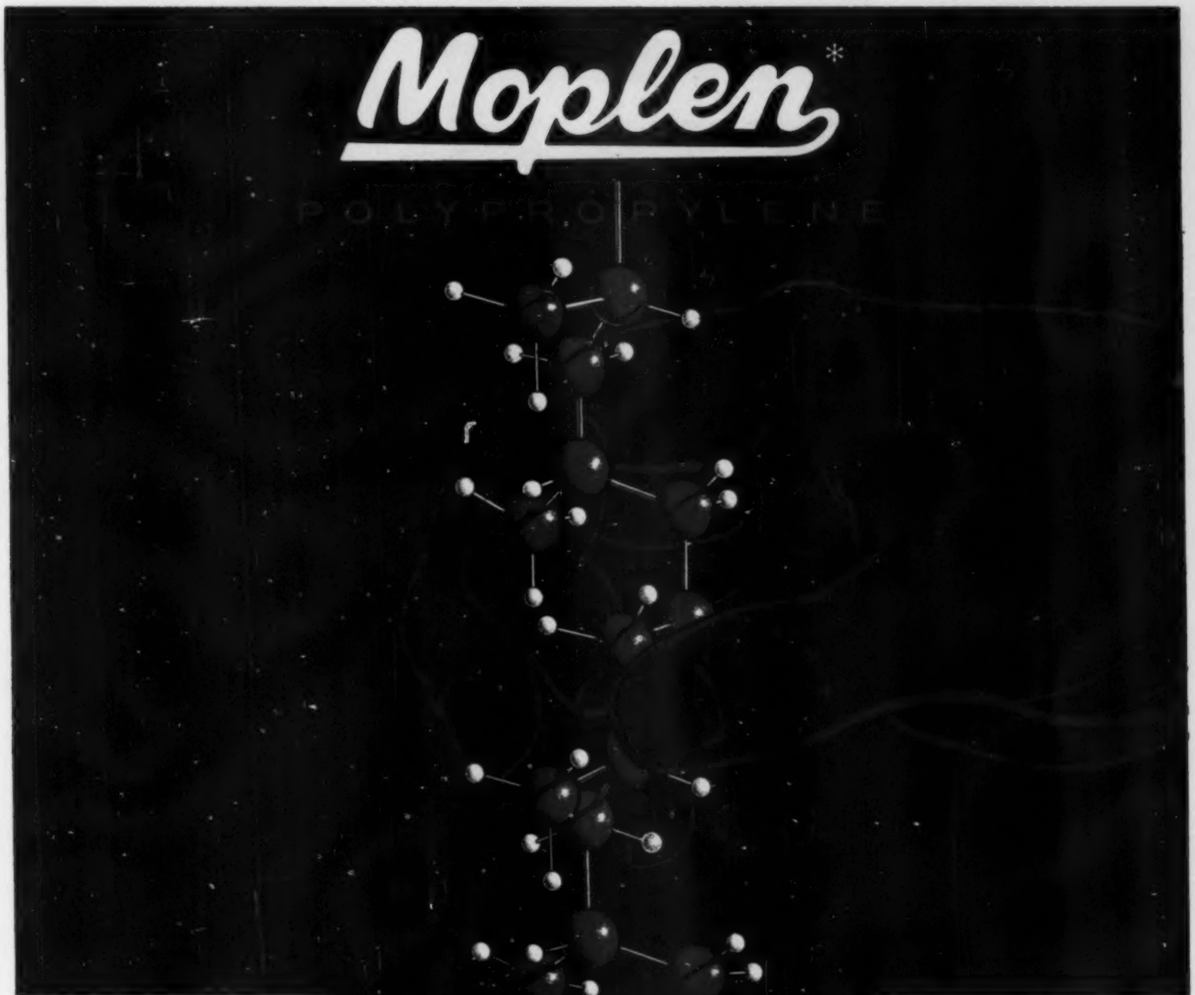

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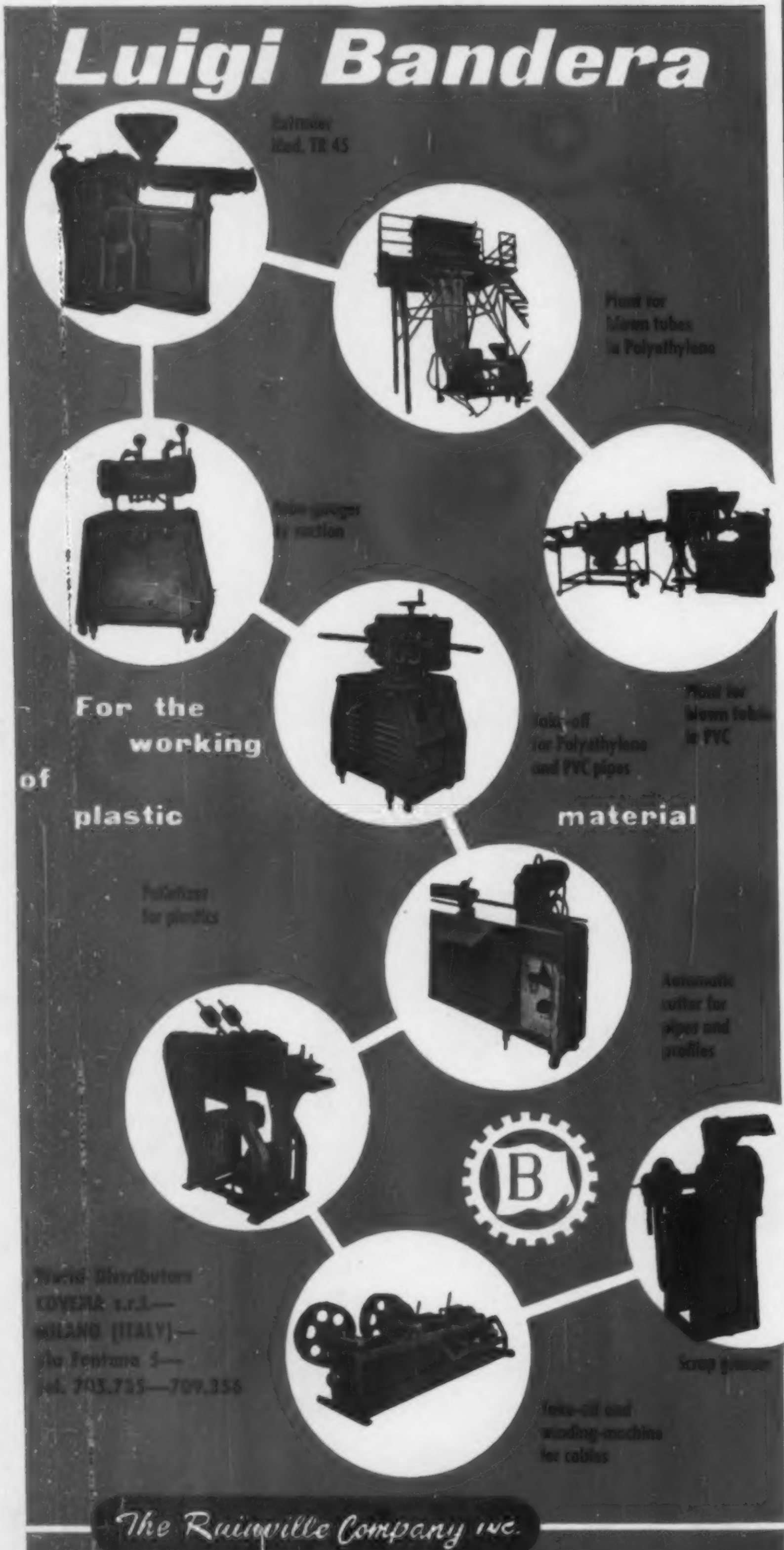

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(From pp. 89-91)

be arc-proof up to 4000 v. per mil, making it a promising insulating material.

Teslar remains usable at 350° F. and is said to be resistant to flexural fatigue at 0° F. Its zero strength temperature is reported to be above 572° F. It is currently available in three types—Type 20, Type 30, and the experimental thermoforming type mentioned above. The primary difference between Types 20 and 30 is the increased dimensional stability of Type 30 at fabricating temperatures above 270° F. Type 30 shrinks less than 5% at 330° F.

Development work with printing inks for use on Teslar indicates that satisfactory bonds and good all-round performance can be obtained with at least one type of ink now commercially available. Others are expected to prove suitable too.

The development of long-lived laminate systems of Teslar on various substrates requires adhesives which will last at least as long or longer than the Teslar surfacing film itself.

Adhesives based on ultraviolet-stable acrylates are reported by Du Pont to have survived testing in most severe applications and over 1000 hr. accelerated weathering under a clear film. Epoxy adhesives and synthetic rubber-based adhesives have performed well in initial hydrolytic testing and hold promise for long-term use under pigmented film where ultra-violet stability is not required. The application of commercially available adhesives has been demonstrated on commercial laminating equipment with epoxies and polyurethanes (based on polyesters). Specific adhesives are being tested for each application rather than one general adhesive for all of the substrates.

From all indications, the new film represents a major contribution to design progress in plastics and offers the design engineer a versatile, new tool with which to solve many of the problems associated with chemical corrosion, outdoor environments, and strength.—**End**

Screwless extruder

(From pp. 107-114)

p. 112, for a 1/16-in. gap size. There is a trend toward greater output/hr./hp. with increased temperature at all rotational speeds. Since flow through the die is restricted, this trend is consistent with the reduction in apparent viscosity to be expected at increased temperatures. The greatest efficiency with respect to the drive power is found at the lowest speed (80 r.p.m.). Since the horsepower listed is the power consumed by the motor and since more heat must be supplied by the strip heaters at low r.p.m., it would be reasonable to expect that greater efficiency would be found at lower speeds. This same trend was found for both 1/32- and 1/8-in. gap sizes.

Although determinations of the normal force in liquids and solutions have been made under no-flow conditions (2, 4), it is not possible to use such data for predictions of pressures developed during elastic melt extrusions. Flow is now taking place through the device and the normal force effect due to the shearing of bulk polymers has not been studied.

Some direct measurements of the pressure developed during the elastic melt extrusion were made using a silicone grease filled bourdon tube attached to the extrusion die. The results are presented in Fig. 9, p. 112. These pressures are very low when compared to those developed in conventional screw extruders. However, the laboratory model on which these measurements were made is relatively small compared to conventional extruders. No prediction can be made as to what pressures could be developed by this method until reliable information is obtained on the effect of rotor diameter and other scale-up factors. Since the extrusion pump and the forming die are contiguous in this elastic melt extruder, pressure is not the controlling factor in extrusion rate.

Residence time, often a prime cause of heat degradation, is reduced markedly by this extrusion process. Residence times ranging from 50 sec. down to less than 9 sec. have been measured using

this elastic melt machine as compared with minutes in the conventional screw extruder. These short times are important in processing heat-sensitive materials.

Output

The gap distance between the rotating bob and the die plate shown in Fig. 3 is constant across the radius. This means that the area of any annular plane parallel to the axis of rotation in the shearing zone will vary with the radius. As a result the flow of material is progressively restricted as it passes through planes of diminishing radii and approaches the die. Conversely, as the die diameter is increased and reduces the length of the shearing zone, restriction is reduced. By using a $\frac{3}{8}$-in. diam. entrance to the $\frac{1}{8}$-in. diam. shaping die, output rates of 6.5 lb./hr./hp. have been measured. It is evident that a coordinated design of the gap cross-section and die inlet can produce marked improvements in output rate. A machine based on the work presented here has been built by another laboratory and output rates of over 12 lb./hr. have been achieved with a 1-hp. drive.

The design presented in Fig. 3 was selected as being the simplest possible device with which to study the effect of the variables of r.p.m., temperature, and gap size. Based on the results above, the original design has been improved, particularly with respect to the feed zone and the restriction of flow in the gap. Figure 10, p. 114, presents a cross-section drawing and photographs of the improved design. Here the face of the rotor *A* is a truncated cone, the side of which forms an annular feed zone or a triangular cross-section with the wall of the heating chamber. As the granules fall into the feed zone from the feed tube, *B*, they are forced into the shearing zone *C*, and no spiral or converging feed system is needed. With no positive pressure built up in the outer portion of the feed zone, leakage back over the clearance between the rotor and the supporting case *D*, is no problem.

The shearing face of the rotor is contoured to give an increasing gap with decreasing radius. Thus, the shape of the rotor can be designed to reduce the restriction to flow and to produce any desired compression ratio. The extruder of Fig. 10 was designed with an area in the die cross-section that was 10% less than the area of the annular plane at the outermost part of the shearing zone, *C*. This design also had a mechanism for moving the rotor along its axis of rotation to adjust the gap size during operation and was a satisfactory design for studying the elastic melt extrusion characteristics of several different plastics. Table I, p. 114, lists the various materials that were extruded.

Results with various materials

Both low- and high-density extruded with this device. In general powder of flake feeds more easily than granules, but with a polyethylene, of either high or low molecular weights, can be easily slight increase in power consumption granular pellets of $\frac{1}{8}$-in. or larger can be easily handled. In either case the extrudate is a smooth and homogeneous product.

Although high-impact polystyrene and polymethyl methacrylate are in glassy state at room temperature, the elastic melt extruder was found to work equally well with these materials. The plastication of these hard granules is promoted by direct contact with the hot, rolling bank of polymer melt in the feed zone.

Plasticized polyvinyl chloride and polypropylene are two examples of materials which are ideally suited for this device. Both exhibit a high degree of elasticity when in the melt state and the centripetal pumping action is very positive. In addition, melts of both these materials are very tacky and adhere to the surfaces of the rotor and stationary plate, which also promotes the elastic melt effect.

With all materials, controlling the compression ratio, by changing gap size or rotor contour, allows one to control the degree of degassing that takes place.

To demonstrate this, polystyrene beads containing a foaming agent were fed into the elastic melt extruder. With a large gap and, therefore, low compression, low-density foams, of well-dispersed bubbles of uniform size, can be extruded. In addition, no

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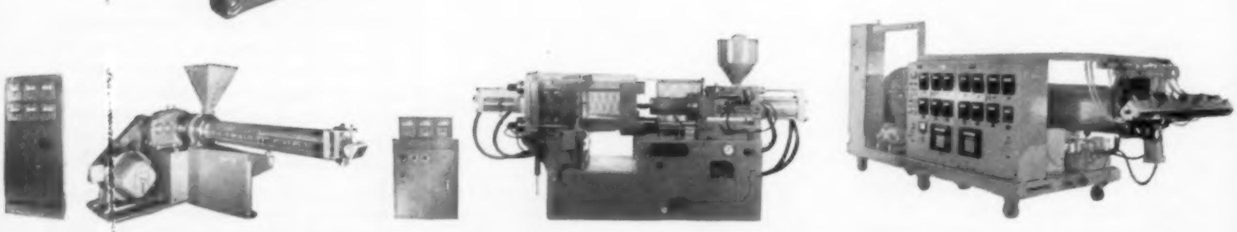

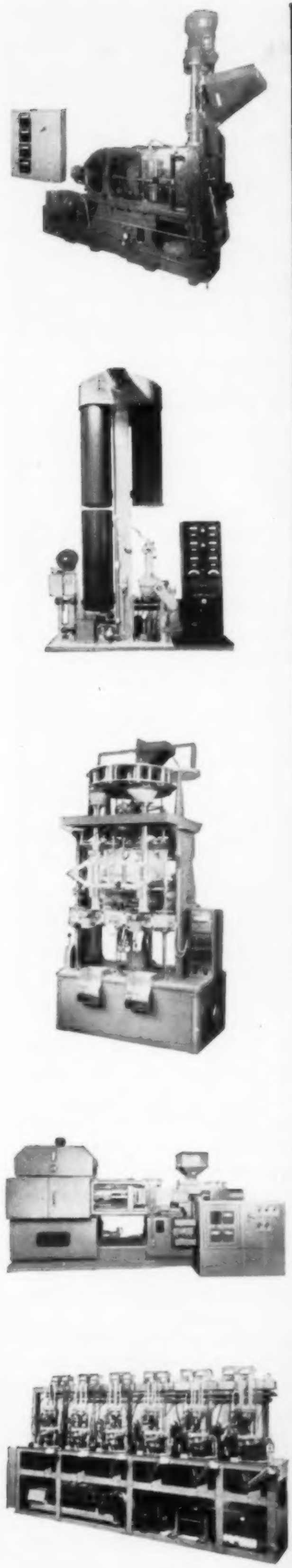

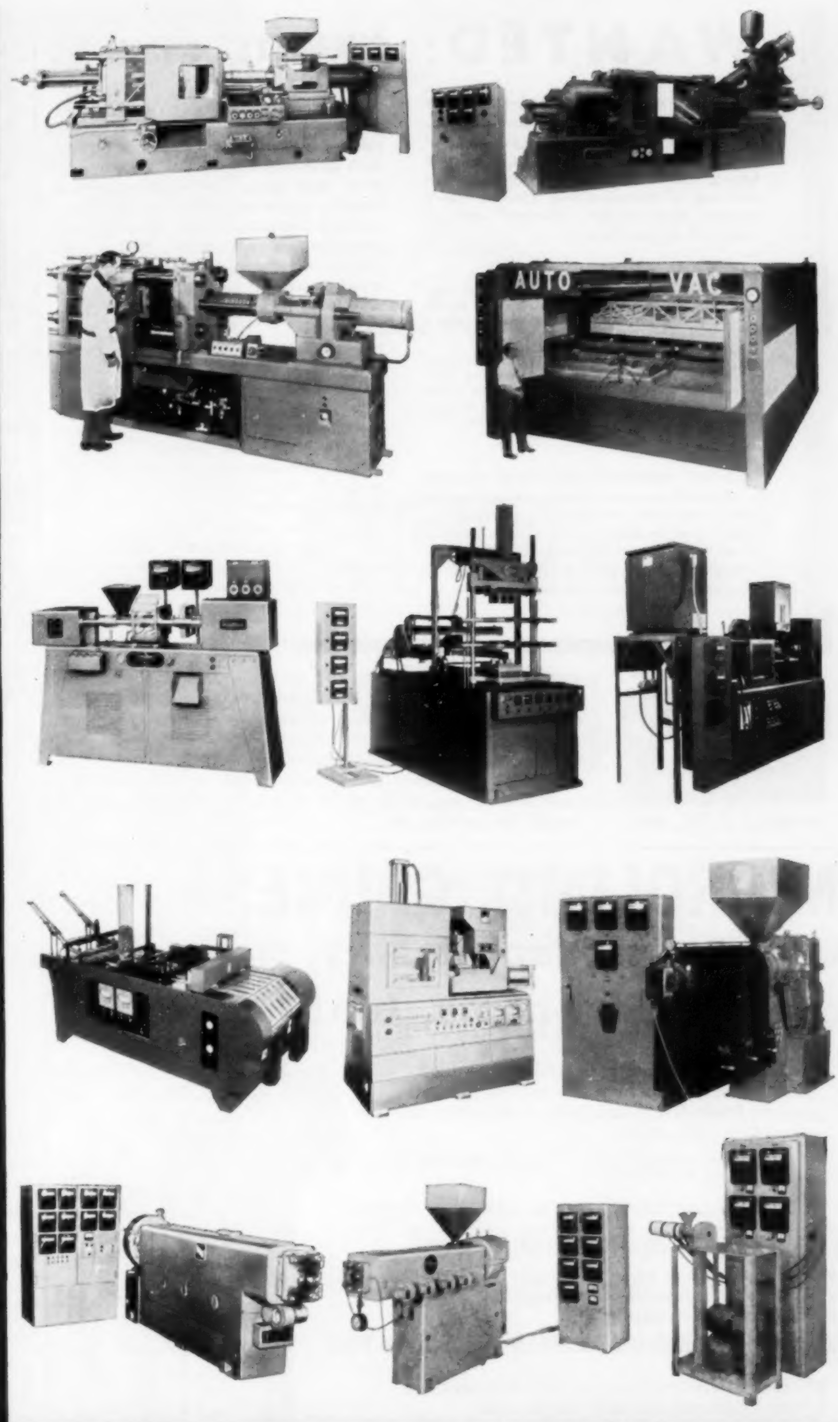
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difficulty was encountered with material flowing back into the feed tube or hopper due to the foaming action. If the gap is reduced, thus increasing the compression ratio, the foaming gas may be completely removed from the melt with the result that bubble-free polystyrene extrusions result. By this method it should be possible to control foam density by controlling the extraction of volatiles. Similarly, cellulose acetate can be extruded without preheating to remove water.

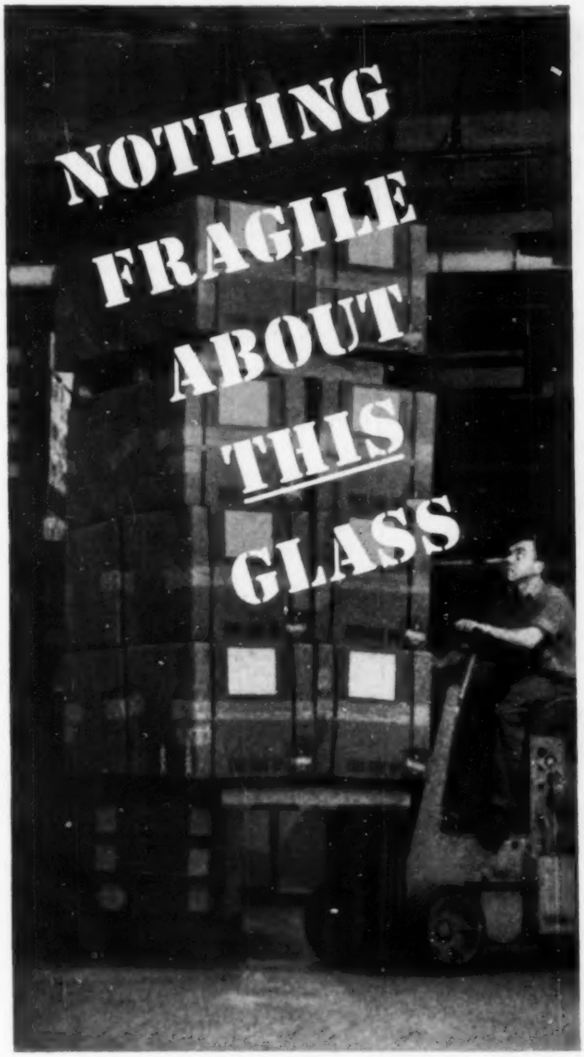
Mixing and dispersing

As mentioned earlier, extruders are used for mixing, compounding, and dispersing. In the shearing or pumping zone of the elastic melt extruder, the material receives the high, uniform, intensive shearing required for good mixing and dispersion. Dry blends of polyethylene containing 1 to 50% carbon black have been processed in this extruder. Microscopic examination indicates good background with some agglomerates even though the residence time was less than 10 seconds. Further improvements in dispersion can be achieved with multiple passes.

Polyethylene can be cross-linked by dicumyl peroxide at elevated temperatures (6). As the cross-linking reaction takes place the melt should become progressively more elastic. Such a reaction taking place in the elastic melt extruder would tend to increase the pumping of material through the extruder rather than the stopping of flow that would take place in a conventional screw extruder. That is, the more cross-linking that takes place the more anxious the material is to come out of the elastic melt extruder. This is true with dry blends of both linear and branched polyethylenes of both high and low molecular weight. Peroxide concentrations from 1 to 2½% by weight have been used. It is possible to control the extrusion conditions so that cure is complete in the hot extrudate within a few inches after leaving the die.

Wire coating

The flow pattern in the elastic melt extruder is such that polymer melt is pumped toward the



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die from all directions. Since the axial length of the device is relatively short compared to the conventional screw extruder it appears possible to coat wire by feeding the conductor directly through a hole along the axis of the bob. The flow pattern eliminates the knitting problem often associated with conventional crosshead die wire coating.

Conclusions

1) Polymer melts exhibit a strong normal pressure force effect. This effect can be used to extrude plastics at rates and efficiencies comparable to the conventional screw extruder.

2) Since only a small amount of polymer in the form of a thin section is being heated at any given time, heat transfer is facilitated and the problem of heat degradation is reduced due to the short residence time. Residence times of less than 9 sec. have been measured in this new device.

3) Mixing and dispersion can be achieved in a short time due to the intensive local shearing of the material. Carbon black dispersions in polyethylene with good background can be achieved even with these low residence times.

4) Cross-linking during extrusion is possible in this machine since the elastic character of the melt, responsible for the pumping action, is increased by the development of cross-links.

5) The extruder can be used to degas or dry materials by controlling the compression ratio.

6) Because of the unique design pressure pulsations at the die are not a problem.

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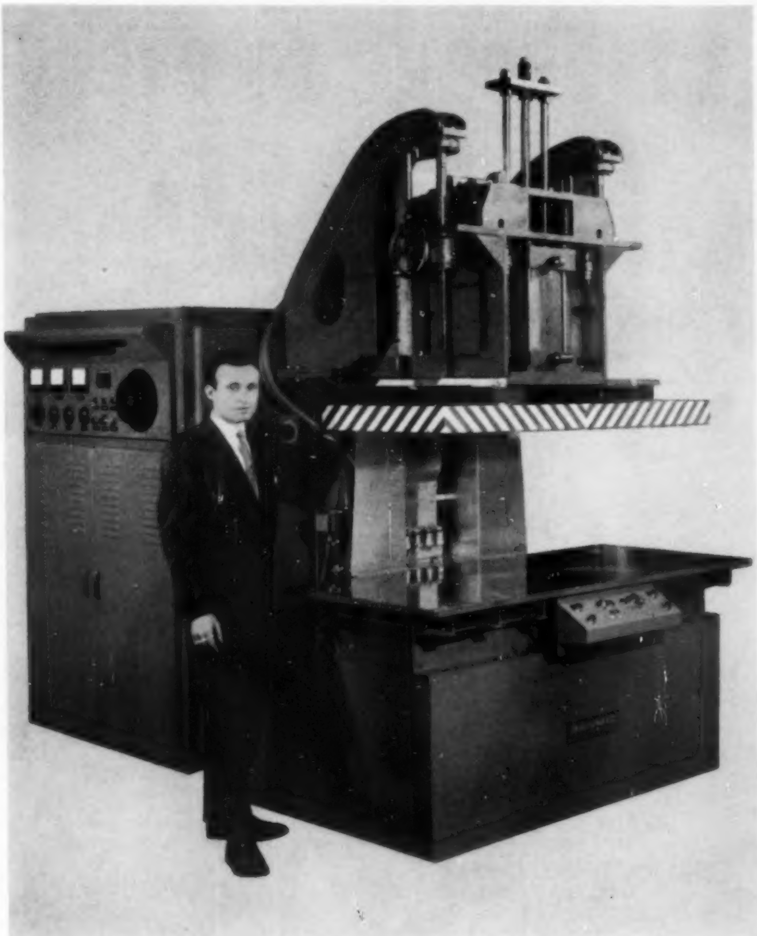

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Injection molding

(From pp. 115-124)

either Eq. 27, velocity as a function of time, or Eq. 31, distance as a function of time, may be used to describe the motion in the cavity. An alternate viewpoint is also available, for by combining the two equations, the relationship between velocity and distance may be obtained.

$$\frac{V}{V_0} = 1 - \frac{X}{X_f} \qquad \text{Eq. 34}$$

The simplicity of this equation as compared to the theoretical Eq. 20 is startling, to say the least.

Consider now the practical problem of filling a cavity of length X_L. The conditions which will just barely fill a cavity exist when V_o is such that the fill-out just equals X_L and the fill time from Eq. 32 is infinite.

If the cavity is shorter than the above value the velocity will fall linearly with distance and exponentially with time until it is forced to zero by the infinite resistance of the closed end of the cavity and the fill time will be given by Eq. 32.

If, under the same conditions, the cavity opens into a second cavity, the velocity falls in the first cavity in the same manner as before, but when the wave front reaches the end of the cavity it leaves with the velocity

$$V_{L1} = V_{01}\left(1 - \frac{X_{L1}}{X_{f1}}\right) \qquad \text{Eq. 35}$$

enters the second cavity with the velocity

$$V_{02} = V_{L1}/S_1 \qquad \text{Eq. 36}$$

and then continues to fall as given by Eq. 27; but now the Constant B jumps to the value corresponding to the second channel. The flow then continues until it either approaches X_f for the second cavity, is stopped by a wall, or enters a third cavity and so on.

Although the nature of the flow has been determined, the more formidable problem of explaining its simplicity and relating the constants V_0 and B to fundamental properties remains.

It is clear that B must depend at least upon all the rheological and thermal properties of the polymer, the die and inlet polymer temperatures, and the cavity geometry and temperature. The cavity inlet velocity, V_o, cannot be affected by cavity temperature or geometry (except for the area factors) although it may depend upon all the other variables which effect B. In addition V_o must also depend upon the ram pressure applied.

A useful starting point is a comparison of the experimental results with those expected for isothermal flow. If both the cavity being filled and the preceding channels are isothermal, Eq. 19, p. 111 of Part 1, can be integrated by combining it with Equation 22. The resulting relationship between X and θ upon differentiation yields

$$V = \left[\left(\frac{R_T}{P_r}\right)^{n+1} + (n+1)\frac{R}{P_r}\theta\right]^{-\frac{n}{n+1}} \qquad \text{Eq. 37}$$

and R_T can be eliminated by applying Eq. 16, p. 111 of Part 1, at

the instant the wave front enters the cavity to give a relationship that is as follows:

$$\frac{V}{V_0} = \left[1 + (n+1)\frac{R}{P_r} V_0^{\frac{n+1}{n}} \theta\right]^{-\frac{n}{n+1}} \quad \text{Eq. 38}$$

The decrease of velocity with time is now caused entirely by the increase of length of filled cavity. The value of *B* for the model is obtained by differentiating Eq. 38 and dividing by *V*,

$$B = \frac{1}{n} \frac{P_r}{R\,(V_0)^{\frac{n}{n+1}}} + \frac{n+1}{n}\theta \quad \text{Eq. 39}$$

and it is clear that this functional form is quite different from experiment where *B* is a constant.

If the value of *B* at time zero is obtained from Eq. 39 and substituted into Eq. 38 there results,

$$\frac{V}{V_0} = \left[1 + \frac{n+1}{n}\frac{\theta}{B_0}\right]^{-\frac{n}{n+1}} \quad \text{Eq. 40}$$

It is interesting to observe at this point that this isothermal equation needs three constants for its description so that adding the complexities of heat transfer has *removed* a constant and *simplified* the form of equation.

Equation 38 is compared with experimental results in Fig. 12, p. 124. The three runs differed only in the die temperature. The average V_0 for the runs was 22.3 cm./sec. and this value was used in the isothermal calculations. This is equivalent to assuming that the experimental value of R_T at time zero is R_T in the isothermal case. *R* was calculated from Eq. 12, p. 108 of Part 1, with I = A and

$$K = \frac{1}{(n+2)\,(2)^{n+1}}$$

The rheological constants used are given in Table I.

The actual pressure applied to the molten polymer is estimated to be in the range of 10,000 to 18,000 p.s.i. and isothermal curves are presented for two values of P_r to show that the actual pressure is relatively unimportant—in all cases the experimental velocity falls off much more rapidly than the isothermal velocity. (It is easy to show that the isothermal fill-out is infinite.) The difference between the calculated and experimental curves is undoubtedly caused mainly by the heat transfer in the die and as time increases the cooling of the polymer increases and the experimental values diverge increasingly from the isothermal ones.

Shift in curves

As the die temperature is increased the experimental curves shift towards the isothermal and in the limit where the die temperature equals the cylinder temperature the flow would be isothermal (except for heat generation). Thus somewhere between a die temperature of 180 and 350° F. the velocity-time curve should shift from the exponential towards the hyperbolic type which is characteristic of isothermal flow.

The qualitative as well as quantitative differences between isothermal and non-isothermal flow indicate that the relationship between the experimental results and material properties and system parameters must depend strongly upon the heat transfer in the die. This coupling of the equations of motion and conduction will be considered by the authors in a later study.

Acknowledgment

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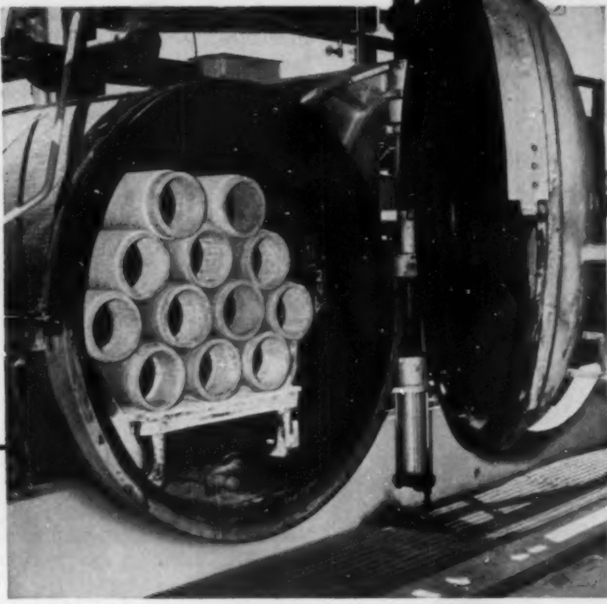

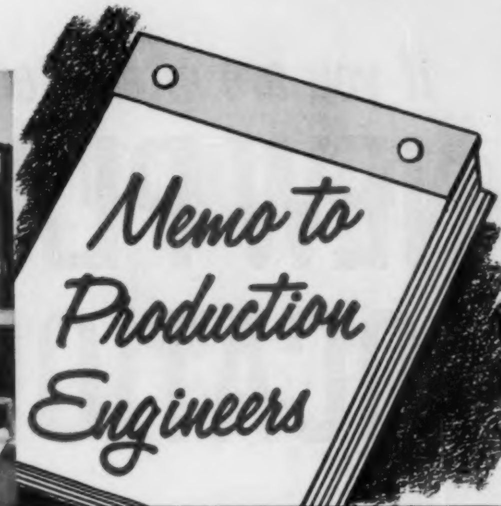

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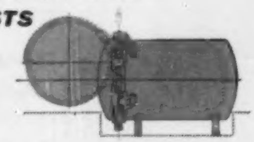

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Plastic glazing

(From pp. 129-131)

temperature glazing will consider insulation to minimize thermal flow from the outer metal edging into the laminated plastic edging. In addition, there will be a requirement for high temperature sealants. Present silicone sealants withstand temperatures approaching 500° F. for extended periods, and silicones presently under development give promise of functioning for shorter periods in the 600 to 900° F. range.

Polishing for optics: Experience has shown us that most of the thick MIL-P-8184 sheets purchased for stretching have minor optical surface deficiencies. These enlarge during the stretching operation, and if left untreated, result in an optically unsatisfactory sheet. Our grinding and polishing techniques have been extended to refinishing our stretched acrylic before forming, with an end result of equal or better optics than those available in as-cast sheeting. Techniques have been developed for grinding and polishing each of the various transparent materials with which we are now working.

Design configurations

Assuming some temperature ranges, the configurations shown in Fig. 3, p. 131, may be considered as a start for design thinking.

160 to 220° F.: Present designs are adequate, using as-cast or stretched Plexiglas 55 or Sierracin RC-500, edged with acrylic laminate reinforced with nylon fibers.

220 to 325° F.: Laminated or double-glazed all-plastic configuration using Sierracin 880 or 890 or Selectron 400 as outer heat shield, with stretched acrylic inner structural member, edged with epoxy laminate reinforced with nylon fibers.

325 to 450° F.: Double glazed with plastic heat shield and stretched acrylic inner structural member for short duration. Double glazed with glass heat shield and stretched acrylic inner structural member for long durations. Edged with phenolic-epoxy laminate reinforced with mixed glass-synthetic fibers.

450 to 1000° F.: Double or triple glazed with floating glass

outer heat shields and laminated inner plastic composite consisting of outer plastic heat shield and inner stretched acrylic structural member, edged so that the outer metal edging is insulated from the inner plastic laminate edging.

The double-glazed concept is not new in aircraft enclosures. We have produced more than 17,000 individual double-glazed assemblies for the F-84, B-57, and F-105 series airplanes. Many thousand double-glazed windows have been produced for commercial aircraft. Double glazing with an outer heat shield of special glass and an inner structural member of laminated or monolithic plastic is proposed as a sound approach to the problem of glazing for aircraft of the future. Materials are currently available for double glazing tomorrow's aircraft. Better glass and plastics now showing promise will eventually be available.

Space vehicles

Design concepts of space vehicles will be far more critical than those applicable to present aircraft. For one thing, weight saving becomes extremely important, since a pound of weight saved in spacecraft structure can reduce the gross take-off weight of the vehicle by 1000 pounds. Because of this weight problem alone, it seems highly probable that plastics will furnish the major requirement for glazing for space vehicles, particularly in view of preliminary research data which indicates that today's transparent plastics would be suitable for flight in space, although some protection would probably be necessary when leaving or re-entering the atmosphere. Such thermal shields could be glass or ablative laminates, or perhaps sliding shields of metal, in those applications where visibility is unnecessary during a take-off and landing programmed by a computer. The effect of space radiation on plastic materials has been considered, both ultra-violet and nuclear radiation. Transparencies have already been stabilized to resist the level of ultra-violet energy which reaches the earth's surface. There is no long term data as yet to indicate whether this stabilization can be extended to resist higher intensities in shorter wavelengths to be encountered outside the earth's atmosphere. However, preliminary data from the Explorer satellite indicates that degradation from the high nuclear radiation levels found in the Van Allen belt would have no appreciable effect on transparent plastics over periods of many years. Outgassing of plastic materials under the high vacuum of outer space may well be a problem, and this can be combatted by glass facings bonded to the transparency material. The primary factor limiting the development of suitable spacecraft glazing is the absence of a firm objective. We don't yet know the nature of the requirement.

Several products have been mentioned by tradename as being suitable for use in high temperature aircraft glazing. We have undoubtedly omitted mentioning some others which would have fitted into our list, had we been working with the product.—**End**

Ethylene-butene

(*From pp. 132-140*)

polymers that are used in producing warp-free moldings should be a point of major interest to all injection molders.

It should be noted that the improvements in flow and decrease in warpage are accompanied by a small decrease in stiffness. A stiffness value of about 115,000 p.s.i. may be expected which is still considerably above that of most of the other polyethylenes.

Fibers: High density polyolefins are finding wide application as low cost, high tenacity monofilaments for rope, seat covers, webbing, cordage, and decorative uses. The new lower density copolymers offer virtually the same properties as the high density polymer, together with a substantial improvement in performance under continuous load.

This is apparent from Fig. 5, p. 138, which depicts typical creep curves for filament from the new resins as compared with the 0.96-density polymer. The time to failure and the deformation under stress are improved with a low-melt-index copolymer filament sustaining 20,000 p.s.i. in excess of 7000 hours. The excellent load-bearing characteristics will greatly extend the use of high density polyolefins in numerous monofilament applications.

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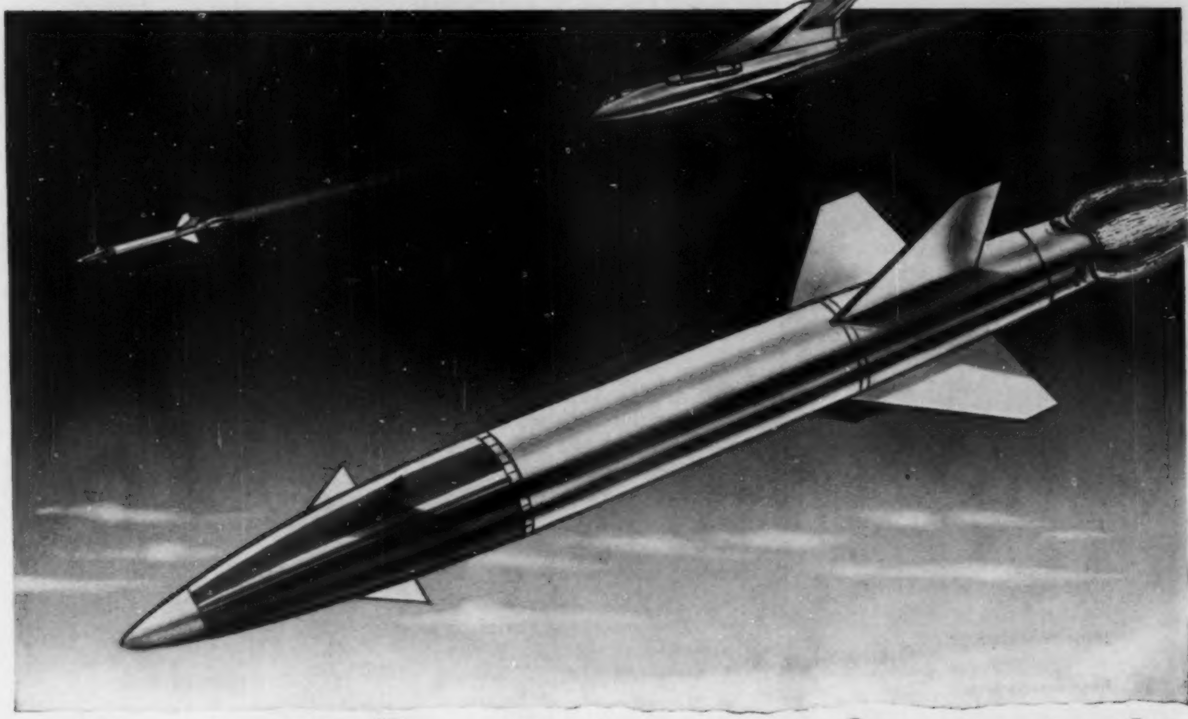

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Polyolefin resins

(From pp. 142-146)

increase the tensile and flexural strengths and heat distortion temperature of the resin.

The curing recipe was prepared by addition of the glycol to the resin at room temperature. The mixture was then warmed to 50° C. and the molten maleic anhydride at a temperature of 60° C. added to the resin.

The mixture was stirred and poured into the proper molds, or used in preparation of laminates. Typical mechanical and electrical data for cast A20-75 epoxy resin cured with the maleic anhydride-propylene glycol system are given in Table IV, p. 146. The effect of amount of cure agent on resin properties is presented in Table V, p. 146.

A room temperature cure of A20-75 resin was achieved at a high level of the curatives by premixing the maleic anhydride and propylene glycol 20 min. at 75° C. before blending with the resin. The mixture was rigid after 3 hr. at room temperature. After a postcure at elevated temperatures the resin displayed a flexural strength of 12,100 p.s.i.

Laminates were prepared with A20-75 resin containing 30.8 p.h.r. maleic anhydride and 8.0 p.h.r. propylene glycol, and 12 plies of #181 Fiberglas cloth (Volan A finish). A molding pressure of 20 p.s.i. was used with a cure time of 9 min. at 135° C. The rigid laminate was then postcured 2 hr. at 150° C. to develop maximum properties: flexural strength 65,400 p.s.i., flexural modulus of elasticity 3,090,000 p.s.i.; flexural elongation 2.4 percent.

Polyphenols: A20-75 resin is reactive to phenolic compounds. Polyfunctional phenols, e.g., bisphenol A and resorcinol, are effective cross-linking agents, giving hard three-dimensional cured polymers. Curing schedules and properties of A20-75 resin cured with polyphenol are given in Table VI, p. 146.

Acknowledgment

The authors wish to acknowledge the help of Dr. C. A. Heiberger and Dr. G. Nowlin, who discussed many of the ideas set forth in this paper, and who assisted us during the preparation of these studies.

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Report on the British Show ...

Glass-reinforced plastics made the big impact at the 1959 International Plastics Exhibition held in London June 17 to 27. No less than one-sixth of the 300 exhibitors featured them in some way or other. For the rest, there was progress on all fronts without sensational new advances. In polyethylenes, the chief new interest was in the higher-density materials, still relatively new in U. K. Polypropylene made its British debut in sundry applications, but the material was imported.

In the machinery and equipment sphere, the show pinpointed the great concentration on pre-plasticizing and screw plasticization in injection molders. Noticeable trends: more blow molding machines, faster working vacuum forming machines, and increased use of haul-off and take up equipment on extruders.

Outstanding applications

Star application of the show was the injection molded implosion television screen guard of Diakon acrylic polymer MG, shown by I. C. I. Ltd., suppliers of the material. Formerly, all screen guards have been formed, a slow and fairly costly process. Injection molding has cut the time by about 75 percent.

Colorfully indicative of the vast range of glass fibre/polyester applications were two sizable swimming pools. The larger of the two, by Microcell Ltd., was 40 ft. long by 16 ft. wide, built up from 4-ft. sq. panels, each weighing approximately 50 pounds. Pools can be built up in this way to almost any reasonable size from a minimum of 4 by 4 feet. They can be erected on any good surface without having to dig a pit; and can readily be dismantled.

The second show pool, shown by Fibreglass Ltd., was a 20-ft. one-piece model molded from chopped strand mat and surfacing mat with pigmented resin. The casing for a 90-hp. stationary Bedford Diesel engine is produced in polyester/fibrous glass, by the hand lay-up process by W. & J. Tod Ltd., Ferrybridge, Weymouth. The casing has been formed from a total of nine moldings, including a 15-gal. translucent fuel tank and a radiator ducting.

How good is the contact molding process which, after losing favor for some years, is now regaining support? Scott Bader & Co. Ltd., Wollaston, Northampstonshire, England, report that practically all the applications of their Crystic polyester resins for reinforced plastics have been produced by contact molding. These applications range from imitation ice cream sundaes for display, to car and vehicles bodies, translucent roof sheeting, aircraft radomes, ducting, pipes, furniture (chair frames and case goods), crash helmets, twin screw cabin cruisers, luxury launches, bodies for medium sized delivery trucks (runabouts), and others.

Progress in the use of polyester/glass fibre for outdoor garden settings and indoor furnishings was shown at the stand of Bakelite Ltd. One, a garden setting, incorporating an imitation random-rubble wall faithful in texture and color to original stone, and "pointed" with a mixture of sand and epoxide resin.

For a power station main condenser, the water box moldings in reinforced polyester resins (from Bakelite materials by Mendip Chemical Engineering, Ltd.) are among the heaviest moldings so far produced in this material for land-based use, with weights about 2 tons. They replace iron castings six times as heavy.

Vinyl bonded to plasterboard

PVC bonded to plasterboard promises big things in building prefabrication. This consists of Storoflex cloth-backed PVC plus the plasterboard, and is made by the British Plasterboard (Mfg.) Co. Ltd. Sizes are up to 16 by 16 inches.

To meet a demand for large pipe fittings of rigid PVC, Aeroplastics Ltd., (Hillington, Glasgow, S. W. 2) have pioneered a new method of mass producing these large moldings on an economical basis. They use rigid, unplasticized, unmodified PVC of high "K" value incorporating a percentage of mineral filler, and have produced shots of up to 6 lb. in weight on injection molders made by Fairey Engineering Ltd., Stockport. Fittings now made include those for non-pressure pipes 4 to 6 in. in diameter, with 45 and 90° bends, 90° T-junction, and 135° Y-junction. The Fairey injection molders are linked with preplasticizing equipment developed from the well-known Oykehouse system (reciprocating piston feeding the preplasticized material into an empty injection cylinder).

Durapipe & Fittings Ltd. also state that they produce jointing with molded fitting in sizes up to 6 in., the largest made anywhere in the world to date. Previously, the only large size fittings were fabricated and had to be imported from U. S. A.

Monsanto Chemicals Ltd. say that nothing quite like their new Permalux decorative plastic wall panels and patented Pellicon floor tiles have been produced in U. S. A. The panels are made from polystyrene, and were developed jointly with Unity International Development Co. Ltd. and E. A. W. Industries (the marketing sponsors). They are molded by Streetly Mfg. Co. Ltd. in a variety of colors, 10½ in. wide by 14 in. long, to supply a luxury finish for interiors at a relatively economic cost.

Siemens Edison Swan Ltd., London, have made a new "find"—PTFE instrument wire, which they are using in electrical equipment, for voltages up to 500 r.m.s. and 1000 r.m.s., and are made to Ministry of Supply (Air) Specifications EL 1930 "B" and "C" (the "B" is equivalent to American "E").

A range of non-toxic Ethypol NT colors has been developed by Williams (Hounslow) Ltd. for use with polyethylene for packaging, especially of foodstuffs. Most of the colors normally used in polyethylene are not permitted to be associated with foods in U. K. Range: green, blue, yellow, red, peach, orange brown. They are intended for moldings, primarily, at present.

The use of organic isocyanate compound Suprasec D with the polyester resins Daltolacs 21 and 22 produces rigid polyurethane foams for insulation purposes.

Machines at the show

Three new machines by R. H. Windsor Ltd. include the AP 200 injection molder equipped with their two-stage twin screw Autoplas preplasticizing equipment, which is capable of the following shot ratings: polystyrene, 124 oz.; polyethylene, 107 oz.; acrylics, 136 oz.; cellulose acetate, 153 oz., and butyrate, 136 ounces. It has a constant stroke 800 tons clamping unit. The preplasticizer has a capacity of 350 lb. of polystyrene an hour, and the swept volume of the injection stroke is 200 cu. in. of plasticized material, the plunger operating at a speed of 325 in./min. on a 17-in. stroke.

Increasing interest in vacuum forming was reflected in a wider range of machines on display. The new 80/50 machine by T. H. & J. Daniels Ltd., Stroud, Gloucestershire, is the largest in their range, to handle sheets up to 80 by 50 in. from 0.01-in. to 1.5-in. thick and is hydraulically operated. An operator loads, starts the cycle, and removes the finished formings. The drape unit is upward moving and the plug unit is mounted vertically above it. Both have provision for admitting air (for pre-stretching or cushioning). By the use of two sheet carrying frames mounted on front-to-rear rails, the cycle speed is increased 50%, one frame being under the batteries of infra-red ceramic type heaters while the other is in process. The Daniels/Latymer Mark 11 30/30 vacuum forming machine, having more powerful plug and drape cylinders compared with

Mark 1, can now handle PVC and its copolymers. It has a drape force of 2250 lb. and a plug force of 1000 pounds. The machine is intended for the more complex type of forming. Provision is made for bubble prestretching where necessary.

Six different molds can be in production at the same time on the new Turnamaticrotary injection molding machines made by Turner Machinery Ltd., Bramley, Leeds. The molds are fitted into the rotary turret head, which is automatically indexed after each injection. The six-station turret head is indexed: 1) injection; 2-3) sprue removal and cooling; 4) cooling; 5) open and ejection; 6) closing.

A new design of heating chamber, which cuts molding cycles by almost half, is now incorporated in injection molders by Peco Machinery Sales (Westminster) Ltd. Heating is applied by four electric elements from within the spreader, in addition to conventional heating from the wall of the chamber. The spreader is scientifically contoured to produce the minimum of resistance to the passage of the plasticized mass—which moves through the chamber in a very thin layer.

West Instruments of Brighton, subsidiary of West Instrument Corp., Chicago, Ill., claim a notable success in Britain for West temperate control instruments. More than 50% of all the machinery shown at the exhibition incorporated West instruments. This was accomplished after only four years' operation. The subsidiary is a leading instrument company in Europe.

Fibrenyle Ltd. is one of the leading manufacturers of blow-molded polyethylene and nylon bottles in Britain. For the purpose it has developed its own production machinery. This equipment, further improved, is now being marketed by an associated company, Amigo Machine Co. Ltd., 16 Gorst Road, London, N. W. 10. It introduced the fully-automatic Blow-Master extrusion-blow molding machine to the trade at the Show. Output is up to 800 an hour on hollow containers, bottles, etc., up to 3½ in. diameter, and 6 in. tall, and the design of the machine also permits the inside of necks to be molded as well. Two identical or different molds may be used subject to the item being of the same color and weight. Important features claimed are rapid starting from cold by sensible over-rating for heating; and speedy tool setting by more clamping to the platens, without the need for guide pins.

Glass fibre-resin spraying equipment is being increasingly used for the production of molded parts. Included with the standard range of equipment shown by Aust & Schüttler u. Co., Düsseldorf, Germany, was a new version intended for civil engineering purposes. It has been used for insulating tunnels, roofs, washrooms and bathrooms, and in Germany and Switzerland for coating cross-road striping with fibre reinforced plastics. Successful tests have also been carried out in the chemical and paperboard industries for the jointless coatings of stock containers and machine parts made of steel, concrete, or stone. A special feature of the equipment is an accessory which allows fillers of any *kind and grain* to be added to the resin spray.

To overcome deflashing problems, the SBP/40 has been made by Guyson Industrial Equipment Ltd. for a leading plastics converter in U. K. It can remove flash up to 9/1000 in. thick from thermoset moldings. The machine can also be used for matt-finishing.

For those who want to print in metallized inks on blown plastic bottles, a new dry ink printing machine by Milford Astor Ltd. gives a result in bright imitation gold or silver four or five times brighter than ink. It aroused considerable interest among the converters at the show. Previously the somewhat unsatisfactory method of screen printing has had to be used. The present equipment has taken two years to develop and employs the plastic tape method of applying color by controlled heat and pressure. First came the model for applying a range of 40 non-metallic colors. The latest is the version of the metallics (anodized aluminium) in five colors (gold, silver, green, blue, and maroon). The blown containers are placed on cradles, and the color applied by curved plates, at 200 to 300 an hour, manually fed. The cycle time is 4 to 5 sec., and dwell time ½ second. Drying time and pre-preparation of materials is eliminated. At present it is available as a rotary model for rounds and ovals, but at the Packaging Exhibition the newer model will be displayed. (U. S. agents: Timadco, Inc., Mineola, N. Y.—**End**

...and the International Convention

More than 3000 delegates attended the Convention with a record average session attendance of 540. Speakers were authorities on the subjects from Holland, Germany, Denmark, Italy, U. S. A., and the U. K.

Polypropylene was discussed at the first session by Dr. J. M. Goppel (mechanical and physical properties) and by G. Campbell (molding characteristics). Dr. Goppel classified polypropylene types according to crystallinity and molecular weight, but showed that for fuller characterization molecular weight distribution was required. He showed that low temperature brittleness could be improved and that good oxidation stability can be obtained. Mr. Campbell stressed the need for a different approach for polypropylene (as compared with PE) for its flow is more viscous and more influenced by molding temperatures and pressures.

A paper by R. N. Lewis, "Some new amine hardened epoxide resin systems and their properties," outlined progress made in overcoming difficulties in handling epoxide systems. New hardeners based on acrylonitrile-modified aliphatic amines, give controlled reactivity with less sacrifice than usual of properties. A new type of flexibilizer was also discussed. Dr. R. R. Smith reviewed "Cross-linking of thermoplastics" in a critical paper which analyzed and compared recent techniques for cross-linking, with particular reference to PVC and polyethylene. The second session ended with a joint paper by J. Benton and C. M. Thomas on "Some theoretical and experimental aspects of block and graft copolymers."

"Recent developments in glass reinforced plastics" were outlined by four speakers, each describing developments in his own country. They were Dr. R. Tunteler (Holland), Dr. R. Kraft (Germany), B. Parkyn (United Kingdom), and H. C. Blankmeyer (U. S. A.). This session was attended by more than 900 delegates, who provoked a most lively discussion.

Two papers were presented to the session on expanded plastics. They were "Recent developments in foamed plastics in the U. S. A." by Miss Betty Lou Raskin and "The influence of bulk density upon physical properties of expanded polystyrene" by Dr. W. B. Brown. Miss Raskin outlined the preparation, properties, and applications of foams in the U. S. A., reviewed the present status of urethane, polystyrene, and vinyl foams, together with other new developments, and gave an account of the foamed smokes ("flokes") which have been invented at Johns Hopkins University. Dr. Brown reported on his investigations into expanded polystyrene and related bulk density to tensile, compression, impact and flexural strengths; he also discussed hysteresis, creep, and indentation and thermal conductivity.

The final session was devoted to extrusion. D. A. Lannon and G. C. Karas gave an account of their "Studies in the extrusion of thermoplastics," in which factors affecting quantity and quality of extrudate were investigated, using a single screw extruder with extensive instrumentation. "The extrusion of acrylics" was described by L. Griffiths. Suggestions were made for basic design of equipment to obtain quality extrudate, with emphasis on dies, finishing gear.—**End**

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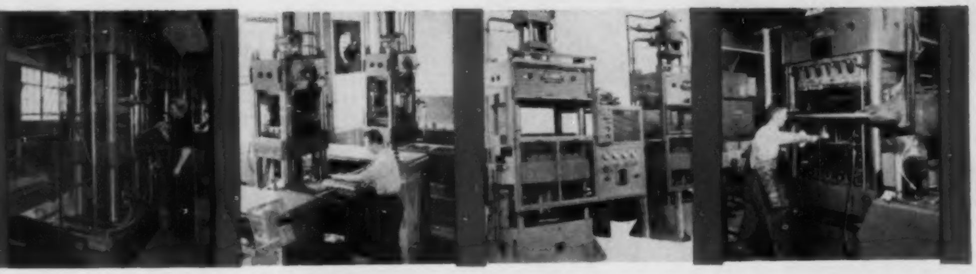

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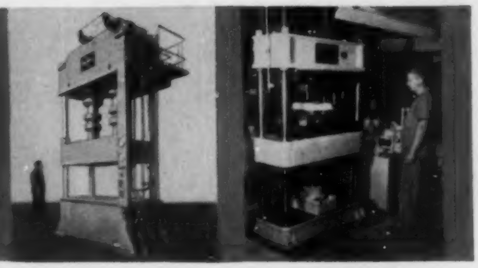

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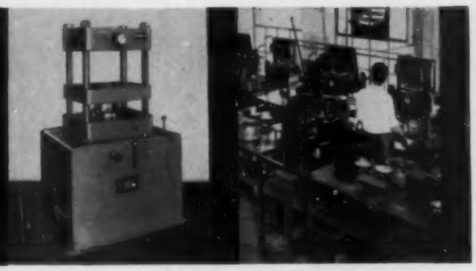

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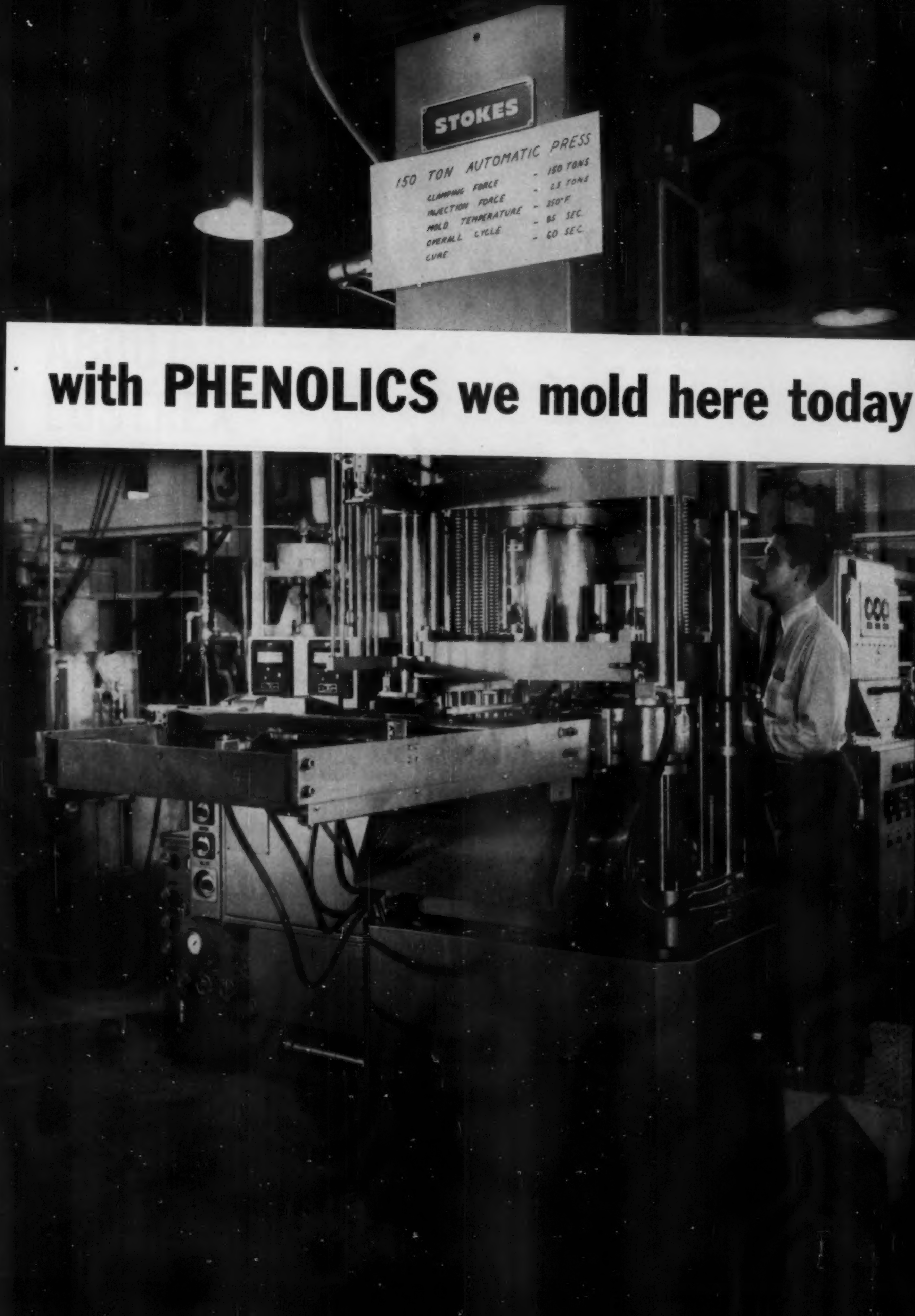
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THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 37)*

October 1959

Bright prospects for vinyl-metal

Sheet metals to which vinyls have been applied, whether as dispersion coating or by lamination, are growing fast in volume and are opening up markets that can only be termed fabulous. (See also MPl, April 1958, p. 102; Sept. 1958, p. 96).

William G. McLain, B. F. Goodrich Chemical Co., has analyzed the markets, and his findings are summarized in the table at right. Mr. McLain, in making this assessment, cites these properties of the material: 1) Textured and printed surfaces in unlimited colors; 2) resistance to acids, bases, salts, and many other chemicals; 3) abrasion resistance; 4) heat insulating and noise reducing characteristics; 5) noncombustibility; 6) ease of cleanability and maintenance; and 7) ease of fabrication into a wide range of finished articles.

Two of these properties—abrasion resistance and ease of fabrication—are particularly important, because they are the key to present and future markets.

Vinyl-metal will compete with baked enamel, alkyd, and other coatings presently used on metals. For instance, over 1 billion sq. ft. of enameled steel are consumed annually. Vinyl could successfully replace much of the enamel coating, except, of course in those applications where high temperature resistance is required.

The first and most obvious area in which vinyl-metal will be used is in the home appliance field. Here, we have approximately 27 million articles sold in 1958. These are washers, dryers, freezers, refrigerators, radios, and television sets that consume approximately 175 million sq. ft. of coated metal per year. There is a definite trend to have appliances blend with the interior decorating scheme. Vinyls are a natural for this market because of the unlimited colors and textures available. Manufacturers like the cost reduction made possible by post-coating formability.

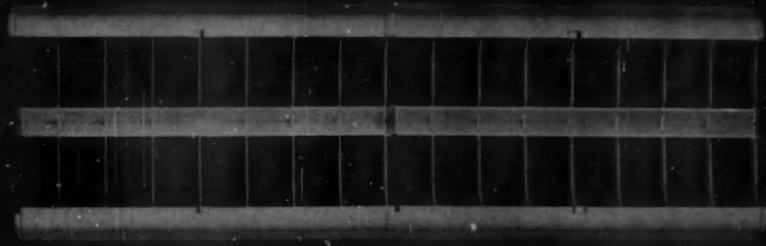
Kitchen cabinets alone use approximately 30 million sq. ft. of coated metal per year. This could be a very good market for vinyl-coated metal; and **(To page 238)**

Potential markets for vinyl-coated metal and vinyl-metal laminates

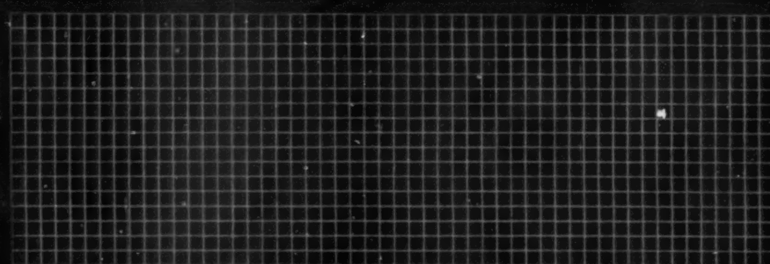
	Year	*Units*	*Vinyl-metal per unit sq. ft.*	*Total vinyl-metal million sq. ft.*
Home appliances				
Air conditioners	1958	1,350,000	4	5.4
Refrigerators	1958	3,200,000	20	64.0
Freezers	1958	1,100,000	20	22.0
Dishwashers	1958	400,000	8	3.2
Washers	1958	3,900,000	8	31.2
Dryers	1958	1,000,000	8	8.0
Vacuum cleaners	1958	3,300,000	2	6.6
Radios	1958	8,000,000	1	8.0
Television	1958	5,000,000	5	25.0
Kitchen cabinets	1958	3,000,000	10	30.0
Office machinery and equipment				
Adding	1954	287,000	2	0.5
Calculating	1954	94,000	2	0.2
Bookkeeping	1954	45,000	12	0.5
Typewriters				
Desk	1954	595,000	2	1.1
Portable	1954	515,000	1.5	0.8
Cases	1954	515,000	3	1.5
Luggage				
Suitcases	1954	12,000,000	5	60.0
Trunks	1954	872,000	20	17.4
Miscellaneous cases	1954	1,600,000	1	1.6
Vending machines				
Cigarette	1954	60,000	10	0.6
Packaged food	1954	55,000	15	0.9
Bulk food	1954	130,000	15	2.0
Transportation				
Automobile passenger cars	1954	559,000		
Dash boards			4	22
Side panels			20	100
Kick pads			2	10
Trucks	1954	1,038,000		
Interior paneling			10	10
Buses	1954	4,039		
Seat backs			120	0.5
Side paneling			150	0.6
Transit coaches	1954	2,400		
Seat backs			120	0.3
Side Paneling			150	0.4
Railway passenger cars	1954	585		
Arm rests			50	
Side paneling			150	0.1

* Reg. U.S. Pat. Off.

WHAT THEY'RE SAYING ABOUT LUSTREX* PERMA TONE STYRENE



Lighting Fixture Molders: "Easy flow, fast cycles . . ." "No molding job too difficult." "Constant color during molding . . ."



Lighting Fixture Manufacturers: "2 to 3 times more resistant to yellowing . . ." "Exceeds IES–NEMA–SPI specs for light stabilized styrene." "Excellent crystal clarity . . . unlimited color possibilities."

To all the inherent advantages of styrene in lighting—the large areas of illumination, the light weight, good diffusion, unusual design effects—perma tone adds excellent light stability, a resistance to yellowing up to three times better than regular styrenes. Proven in use by leading fixture manufacturers, without formulation changes since 1956, perma tone opens up wide new dimensions in color, including truly translucent whites and other difficult colors.

Lustrex perma tone styrene is available for injection molding or extrusion. Write for complete technical data to Monsanto Chemical Company, Plastics Division, Room 963, Springfield 2, Massachusetts.

Monsanto

*LUSTREX: REG. U. S. PAT. OFF.

THE PLASTISCOPE

(From page 236)

office equipment suppliers can use 4.5 million sq. ft. of vinyl-metal per year. Vinyl will be used for this application because of its superior wear resistance, color possibilities, and maintenance-free surface. Along the same line, estimates of market volume for vending machines are 3 to 4 million sq. feet. These include a variety of dispensers, such as cigarette, soft drink, coffee, candy, and packaged food equipment.

Luggage is already using a large volume of vinyl-coated metal. This industry alone could consume approximately 75 million sq. ft. in the near future.

These applications account for roughly 300 million sq. ft. of coated metal per year at present. If we look a little further, we can see vinyl-metal being used for room partitions, curtain wall construction, and roofing.

House siding and awnings, coated with vinyl are already being manufactured. These products are receiving wide-spread attention. All the major aluminum producers are working on such a product.

Vinyl-metal is already being used in the automotive industry for dash, kick panels, and station wagon flooring. This is expected to grow.

The total annual market for vinyl-coated metal is believed to amount to 1 billion sq. feet. Approximately 15 to 20 million sq. ft. are expected in 1960. This is just the start.

Nylon-6 and Delrin in stock shapes

Cadillac Plastic & Chemical Co. is offering a complete line of nylon-6 rods, tubes, plates, strips, sheets, and large moldings.

Nylon rod and tubes are stocked to 15-in. O.D., 12-in. I.D. Plate in thicknesses to 2 in., and widths to 12 in.; and strip and sheet stock in widths up to 12 in. are included in the company's line.

Cadillac will also mold nylon massive shapes such as propellers, crank shafts, rudders, engine mounts, heavy gears, industrial truck tires, etc., as well as strips, rods, and tubes in nylon 6/6, in its new extrusions plant.

Small diameter extruded rod made from Delrin, Du Pont's new acetal resin, is now stocked in the company's 11 regional warehouses. Production of sheets, tubes, and large diameter rods has been scheduled. The company will ration sales of Delrin shapes until stocks are built up.

It is expected that Delrin shapes will find industrial and maintenance applications for gears, bearings, rollers, slides, and pump parts, and for machining of prototypes. The Delrin shapes will be priced at approximately the nylon level.

ABS pipe in steel center

Perhaps one of the largest single interior networks of plastic pipe in existence has been unveiled as part of the steel industry's newest scientific laboratory—the $5 million research center of Republic Steel Corp.

Drain lines, low-pressure air lines, vent stacks, and vacuum lines throughout the center called for the use of over 10,000 ft. of Republic's SRK semi-rigid acrylonitrile-butadiene-styrene pipe. The entire pipe installation was completed in half the time required for conventional pipe, and cost considerably less, according to the company.

The nearly two miles of plastic pipe saved many man-hours of pipefitters' time that would have been required if other pipe had been used. Also, the use of chemically inert plastic makes it possible to handle highly corrosive chemical wastes, without having to go to costly corrosion-resistant metals or fragile glass.

Plastics courses

The New York Section of the Society of Plastics Engineers has instituted three courses in plastics to be held at the New York Institute of Technology, New York, N. Y. Each will be a 14-week course. The three courses are as follows: Extrusion, to be held on Mondays, under the direction of Leo Gans of Anchor Plastics; Injection Molding, on Tuesdays, under the direction of Irving Rubin, Robinson Plastics; and Process Properties of Plastics, on Thursdays, under the direction of Dr. Alex Sacher of Standard Insulation. Classes will run from 7 to 9 in the evening. The session will begin on October 19, and the fee is $35 per course plus a $5 registration fee. The educational committee of S.P.E. that set up the course was under the direction of Ralph Biondi of W. R. Grace & Co., and Herb Weber of Rotuba Extruders, Inc.

Lower price for epoxy molding powder

A reduction of 35.5% for quantity purchases now brings the price of Hysol 8610 epoxy molding powder down to $1.00 per pound.

This one-component powder, manufactured by Houghton Laboratories, Inc., Olean, N. Y., is said to offer long storage stability; low shrinkage on cure; excellent electrical properties at elevated temperatures; and fast cure at moderate temperatures, coupled with good flow characteristics.

According to the company, this compound, which can be compression or transfer molded, presents no release problems, because it has a built-in mold release agent. Hysol 8610 is used primarily for shells for electrical components and similar uses.

Vacuum coaters meeting

Technical papers to be presented at the Third Annual Meeting of the Society of Vacuum Coaters include the following topics of special interest to the plastics industry: Thick films, lacquer automation and vacuum metallizing; filaments, firing techniques and some causes of discoloration of metallized coatings; vacuum deposited protective films; and a symposium on new equipment. The meeting will be held in the Hotel Biltmore, New York, N. Y., on January 26 and 27, 1960.

Meeting on curtain walls

Discussions and full-scale workshop sessions on sandwich panel design will form part of the program of the **(To page 240)**

When you slide behind the wheel of your 1960 model...

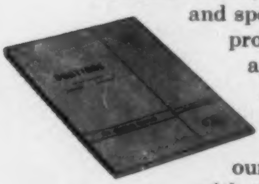
Bee coatings are everywhere!

Even though you're "in the business," the imaginative use of color and varying textures on plastic materials contribute greatly to your desire to own a brand new 1960 car.

Logo Division of Bee Chemical Company has *matched* approximately 150 colors for coatings being used for painting vinyls, ABS copolymers and other thermoplastics. Every major automobile manufacturer has accepted Bee color-matched coatings.
They are used for:

Crash Pads
Interior Door Panels
Center Pillar Post Covers
Hinge Covers
Sill Covers
Arm Rests
Horn Buttons
Dashboard Identifications
Glove Compartment Doors
Instrument Clusters
Exterior Identifications and Trim

Some of these parts require coatings in matched colors, for vacuum metallizing, protective and special-effect coatings. Bee produces coatings for all these applications.



Automobiles are big business . . . but so is yours. Bee knowledge and experience—plus our willingness to provide you with the kind of shirtsleeve service that gets results—can be valuable to you. If you've an unsolved coating application, contact Bee—now!

TRADE MARK

For more complete information about Logo Coatings for thermoplastics, write for Bulletin E-109.

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17000 S. Western Ave.,
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Hartford 3, Connecticut
119 Ann Street
Phone: CHapel 9-7691

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conference organized by the Building Research Institute of the National Academy of Sciences-National Research Council. The meeting will be held at the Shoreham Hotel, Washington, D. C., from November 16-19, 1959.

The three-day sessions on Sandwich Panel Design Criteria will be headed by Dr. Albert Dietz of MIT. The conference sessions will be open to the public. Complete program and registration material may be obtained from Harold Horowitz, Assistant Director for Technical Programs, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

Promotes foams

The Cellular Plastics Division of The Society of the Plastics Industry, Inc. has formed a public relations committee to promote greater public acceptance and understanding of cellular or foamed plastics, including urethane, vinyl, polystyrene, phenolic, and polyethylene. James P. Foley, Allied Chemical Corp., is chairman; Joseph V. Keneally, Union Carbide Chemicals Co., is vice-chairman.

Navy packaging seminars

New information and guidance on packaging for the Navy will be provided through a series of packaging seminars to be held throughout the United States between October 19, 1959 and June 25, 1960. Management and packaging executives of all industries working on government military contracts or contemplating such work in the future, may attend these sessions. Additional details may be obtained from the Department of the Navy, Office of Naval Material, Washington 25, D. C.

Blowing agent for PE and PP

A new foaming agent developed by National Polychemicals, Inc., Wilmington, Mass., is expected to find application for high-melting polymers such as linear polypropylene, high density polyethylene, and nylon-6 resins. It is also recommended by the company for expanding rigid and semi-rigid polyvinyl chloride, and elastomeric materials.

Designated Expandex 177, the new blowing agent decomposes in the temperature range of 460 to 480° F., which is said to be some 90° F. higher than any nitrogen-releasing agent presently available. This decomposition temperature reportedly permits processing at temperatures up to 220° C. without premature blow.

Another DAP compounder

The first facility on the East Coast for manufacturing a complete line of diallyl phthalate molding compounds was put into operation recently by Rogers Corp. at its Manchester, Conn., plant.

Other compounders of DAP are Mesa Plastics Co., Los Angeles, Calif.; Acme Resin Corp., Forest Park, Ill.; and Durez Plastics Div. of Hooker Chemical Corp., North Tonawanda, N. Y. DAP is noted particularly for its exceptionally good electrical and electronic properties. It is claimed to have the top dimensional stability among all the thermosets, in fact, almost no shrinkage. It will withstand continuous heat of temperatures ranging from 350 to 450° F. The largest current application is in connectors.

Fluorocarbon film

The new Teflon FEP fluorocarbon film, which will be available commercially later this year, has properties of major importance to the electrical and electronic industries, according to Du Pont.

Made from FEP resin, the film is said to share practically all of the desirable properties of the older Teflon TFE resin, but has melt-flow properties that permit its extrusion into uniform, pinhole-free films in gages ranging from one-half to 40 mils.

With its heat and corrosion resistance and good electrical insulating characteristics, Teflon FEP film is claimed to offer high performance levels under the most difficult operating conditions. It is expected to be used as extremely thin primary insulation in printed wiring boards, for high-performance flexible printed cables, as a capacitor dielectric, and many similar purposes. Since it is heat-sealable, the film can be fabricated easily. It is also expected to be available as thin-wall tubing.

Synthetic fats from alcohol used in plastics

Plans by Continental Oil Co. to construct a multi-million dollar petrochemical plant at Lake Charles, La., for manufacturing from petroleum a line of industrial alcohols formerly produced only from natural oils and fats, were announced by Harold G. Osborn, senior vice-president.

The Conoco plant, the first of its type in the world, will have a capacity of more than 50 million lb. annually of straight-chain primary alcohols which will be marketed under the Conoco trademark of Alfol for use in the manufacture of plasticizers, detergents, and other products.

At present, petroleum is a basic source of many branched-chain alcohols and low molecular weight straight-chain alcohols. But the higher molecular weight straight-chain alcohols have been dependent on natural sources, such as coconut oil and tallow fat.

Products made from straight-chain alcohols are said to have superior use properties. For example, phthalate esters of straight-chain alcohols are claimed to have better low temperature and permanence characteristics when used as vinyl plasticizers.

Primary raw material for the new products is petroleum-derived ethylene obtained from the ethylene plant operated at Lake Charles by Petroleum Chemicals, Inc., a company in which Conoco owns a 50% interest.

Enters foam field

Pliable and rigid polystyrene from expandable beads is now being produced by The Plastifoam Corp., Rockville, Conn. The flexible material weighs from 0.85 to 1.5 lb./cu. ft. It can be rolled, twisted, or bunched like cloth. It is supplied in sheets or blocks of various shapes, in thicknesses from ⅛ to 2½ inches. Composition is available in sizes to 8 ft. **(To page 242)**

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by 4 ft. by 20 inches. Both types of this material are said to have a K factor of 0.23 to 0.25, tensile strength of 44.46 p.s.i., and water absorption of ½ of 1% by volume.

Vinyl tubing

Extruded tubing for use in soda fountains to carry carbonated water under pressure is now being manufactured from vinyl resin by Pyramid Plastics, Inc., Chicago, Ill. The plastic tubing is wrapped with textile, glass, or metal braid for greater strength and is covered with an abrasion resistant vinyl outer layer. The vinyl resin is Geon, a product of B. F. Goodrich Chemical Co.

Glycol for polyester film

The availability of 1,4-cyclohexanedimethanol for use in the preparation of polyester films and urethane elastomers is announced by Eastman Chemical Products, Inc., subsidiary of Eastman Kodak.

Having two primary hydroxyl groups, this alicyclic glycol reacts readily. It is said to have good thermal and hydrolytic stability, making it a useful intermediate in the synthesis of saturated polyesters intended for use as plasticizers and in the preparation of unsaturated polyesters.

Vinyl sleeving

Development of a new vinyl electrical insulation sleeving called Resinite EP-93C has been announced by Borden Chemical Co. The sleeving is designed to meet the latest revision (B) of Wright Air Development Center Specification MIL-L-7444.

Resinite EP-93C is said to possess low-temperature flexibility to −95° F., complete resistance to fungus and corrosion, and to be self-extinguishing in 1 to 5 sec., depending on tubing size. Dielectric strength is rated at 250 to 340 v./mil, the company states.

PVAc fiber

Air Reduction Chemical Co. is now using the generic term "vinal" to identify the synthetic fibers of polyvinyl alcohol which Airco's Fiber Dept. is marketing. The company, a division of Air Reduction Co., Inc., is developing the U. S. market for the fiber known abroad as "vinylon." PVAc fibers are used extensively in Japan for textile products ranging from school uniforms and intimate apparel to industrial fabrics and fish nets, papers, and non-wovens.

Adhesives

The following is a compilation of recent news concerning availability of various adhesives that are offered to processors concerned with bonding plastics to themselves or to other materials:

For wall tiles. An adhesive for plastic and ceramic wall tile said to allow up to 12 hr. working time has been developed and placed on the market by Armstrong Cork Co.'s Industrial Div., Lancaster, Pa. Called G-386, this product is a buttery, easy-spreading, white rubber-based composition that is said to remain permanently elastic and not to oxidize, bleed from joints, discolor, or become hard and brittle with age. The adhesive covers about 60 sq. feet per gallon and has a shelf life of about 9 months. Priming is not required on white coated plaster or plaster board the company claims.

Another wall tile adhesive, said to be non-flammable and essentially odorless, has been formulated by Formica Corp., a subsidiary of American Cyanamid Co. Intended for applying Formica wall tile, the material can be sprayed, brushed, or rolled on. According to the company, it has excellent bond and initial grab strength, unaffected by water. One gallon covers 280 sq. feet. Suggested price is $8.50 per gallon.

Wall panels, table tops, and other large areas can be bonded with Plastitak Contact Adhesive, developed by Gordon Lacey Chemical Products Co., Inc., Maspeth, N. Y. It is suggested for combining such materials as decorative laminate, reinforced polyester, plastics, plywood, cotton cloth, metal, concrete, ceramics, and foam rubber.

The delayed tack, bonding strength, water resistance, flexibility and spreading properties are said to make this adhesive suitable for combining flexible and rigid materials. Its chemical resistance is stated to permit application to alkaline surfaces such as plaster and concrete.

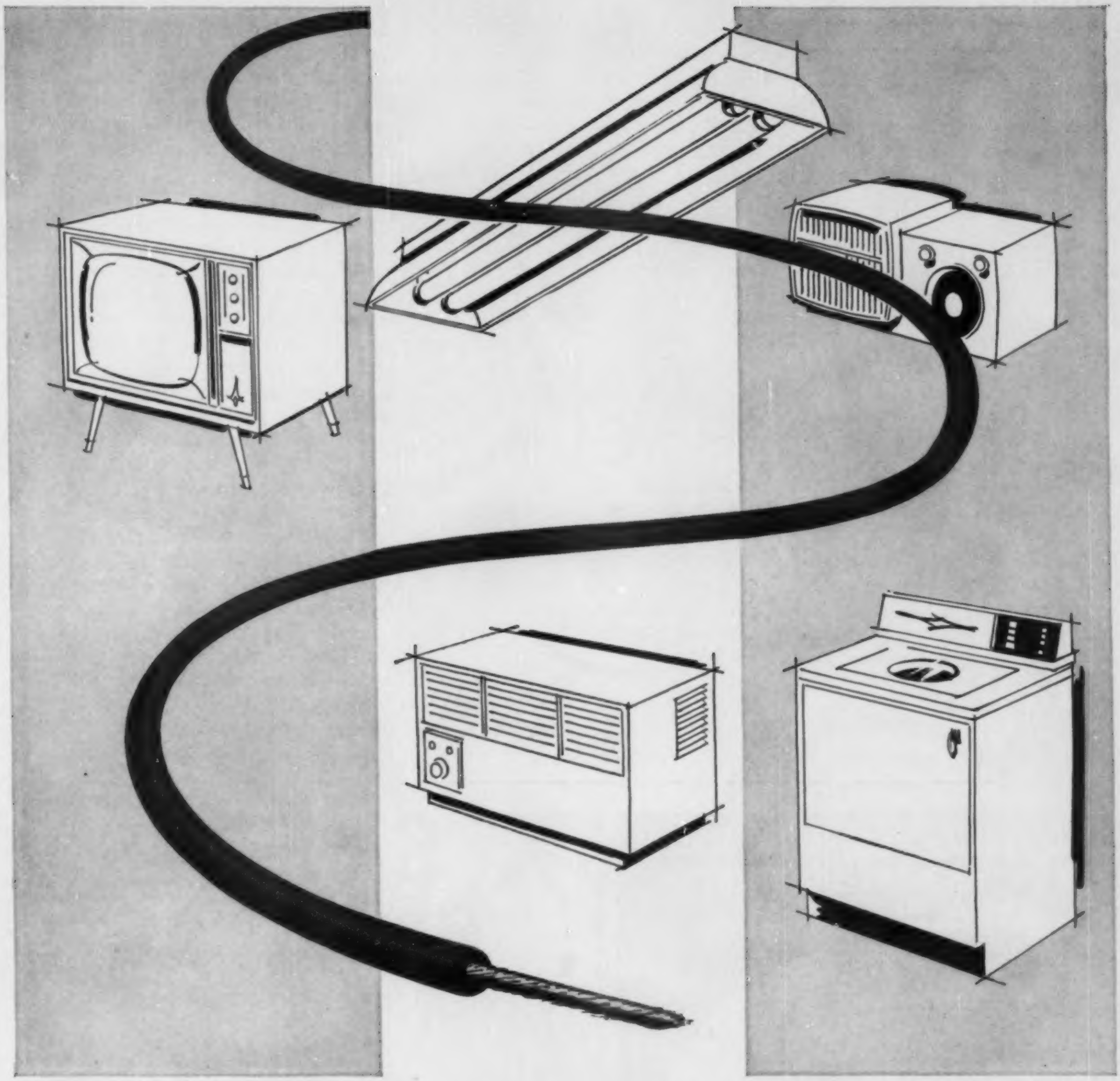
A new group of thermoplastic resin adhesives known as A-100 series, has been developed by Research Sales, Inc., Mahwah, N. J. This series is said to have proved particularly acceptable for polystyrene, vinyl, and acrylic materials. These adhesives are reported to have excellent resistance to alkalies, acids, water, grease, oils, and alcohols.

A thermosetting adhesive, C-680, for hot solvent-free laminations of vinyl films and sheeting to steel and aluminum, has been developed by Gordon Lacey Chemical Products Co., Inc., Maspeth, N. Y. According to the company, it can also be used as a primer for plastisol coatings on these metals. Application is by spray, knife, or other coating.

The adhesive is said to pass all the requirements of S. P. I. Standard Specifications for vinyl-to-metal laminations. It is also claimed to resist exposure to 200° F. for 8 hours. Laminations produced with this adhesive can be deeply drawn without delamination, according to the company.

For acetate. Development of Re-Tac, a clear, water-white, remoistenable adhesive is announced by Adhesive Products Corp., New York, N. Y. According to the company, when applied to acetate and other plastics, the adhesive will dry transparent and tack-free. When moistened with water, an aggressive tack immediately develops, making it possible to adhere the acetate or plastic to glass, metal, wood, paper, and other materials.

Re-Tac is suggested by the manufacturer for use on transparent index tabs and acetate sheets, and in the (To page 244)



(From page 242)

manufacture of adhesive-coated plastic window streamers, which can be adhered merely by moistening with water.

Vinyl plastics can be bonded to metal, glass, cloth, and wood with 2383 Adhesive, developed by Dennis Chemical Co., Inc., St. Louis, Mo. It is used in factory assembly operations for attaching vinyl to furniture or equipment, and in production of paint rollers to bond plastics foam to impregnated cardboard. The dry film is said to be resistant to aliphatic hydrocarbons, water, and oils.

Bonding to metals. An adhesive for bonding metals and glass to cured phenolic, urea, and melamine molded plastics, has been developed by B. B. Chemical Co., Cambridge, Mass., a subsidiary of United Shoe Machinery Corp. Designated Bostik 7026, its principal application is in bonding phenolic sheet to metal in the manufacture of switch and contact assemblies. It is a clear, amber, solvent solution of synthetic resins, stated to have good aging properties, and heat resistance up to 250° F.

Plasticized epoxy adhesive, designated Cycleweld liquid iron, has been introduced by Cycleweld Chemical Products Div. of Chrysler Corp. Intended for the do-it-yourself market, the two component adhesives will be marketed through retail outlets.

Polystyrene foam can be bonded to steel, aluminum, masonite, wood, and many other materials by new adhesives, designated A-827-B, developed by B. F. Goodrich Industrial Products Co., a division of B. F. Goodrich Co. The cemented bond is said to be stronger than the polystyrene material itself. The company recommends A-827-B for use with foamed-in-place polystyrene. Properly bonded assemblies are said to withstand repeated simulated weather cycles involving immersion in water at 120° F., hot water spray or dry air heat at 160° F., and storage at —40° F.

Pre-foamed polystyrene shapes can be bonded to themselves, to polystyrene sheet, or to steel, aluminum, transite, decorative laminates, and to other materials with R-1083-T adhesive another recent Goodrich development. According to the company, this adhesive has no noticeable stress-crazing effect on polystyrene and thus will not collapse the foam. Bonds are said to withstand repeated simulated weathering cycles involving temperatures of 160 to —40° F., plus water immersion and salt spray.

A non-flammable, high strength, high-heat-resistant, adhesive for bonding polystyrene and methane foam, to themselves and to other materials, such as wood, concrete, and metal, has been announced by Rubber & Asbestos Corp., Bloomfield, N. J. Designated Bondmaster G-459, the adhesive is water dispersed and **(To page 246)**

...you can make POLYETHER FOAMS that are SELF-EXTINGUISHING

Major Applications

High and Low Temperature Insulation
- refrigerators
- air conditioners
- piping

Flotation Equipment and Installations
- boats
- aircraft

Core Materials
- building panels
- doors

Encapsulation

Write for complete information.

Now, at the same cost as ordinary polyether prepolymers, Pelron brings you Resin #9665—a resin from which you can make rigid foams that are fully self-extinguishing or even totally non-burning!

Polyether #9665 requires no additives to give it its unique freedom from fire hazard. It is self-extinguishing because of its internal molecular nature. And, it is as easy to use as any regular polyether prepolymer, demanding no stirring as is the case with polyethers depending on various additives for self-extinguishing characteristics.

Flame impingement merely causes charring—with a complete absence of dangerously dripping, sputtering hot materials.

Suitable for both free-foaming and molded applications, #9665 can be controlled to yield foams ranging from 1.8 lbs./cu. ft. upwards.

PELRON CORPORATION

7647 W. 47th Street • Lyons, Illinois

(From page 244)

solvent attack on the foam cells is said to be eliminated. Bonds made with the new product resist humidity, freezing temperatures, and maintain strength throughout a temperature range of from —35 to 250° F., as well as short-time exposure to temperatures up to 350° F., according to the company.

Urethane foam and vinyl foam can be bonded with Rubbaseam, an all-purpose, transparent cement developed by Rubba, Inc., New York, N. Y. It may be applied by brush or machine, and dries in minutes, losing all depression tack within a few hours. It is suggested for bonding foamed toppers to curled hair, jute, and other materials.

Epoxy adhesives. A new group of high strength epoxy bonding agents, designated Cepox-400 series, has been introduced by Chemical Development Corp., Danvers, Mass., for cementing cast iron, steel, copper, aluminum, plastics, and other surfaces to themselves or each other. Besides bonding similar and dissimilar materials, these adhesives are used for sealing and filling gaps. They are made up of 100% solids.

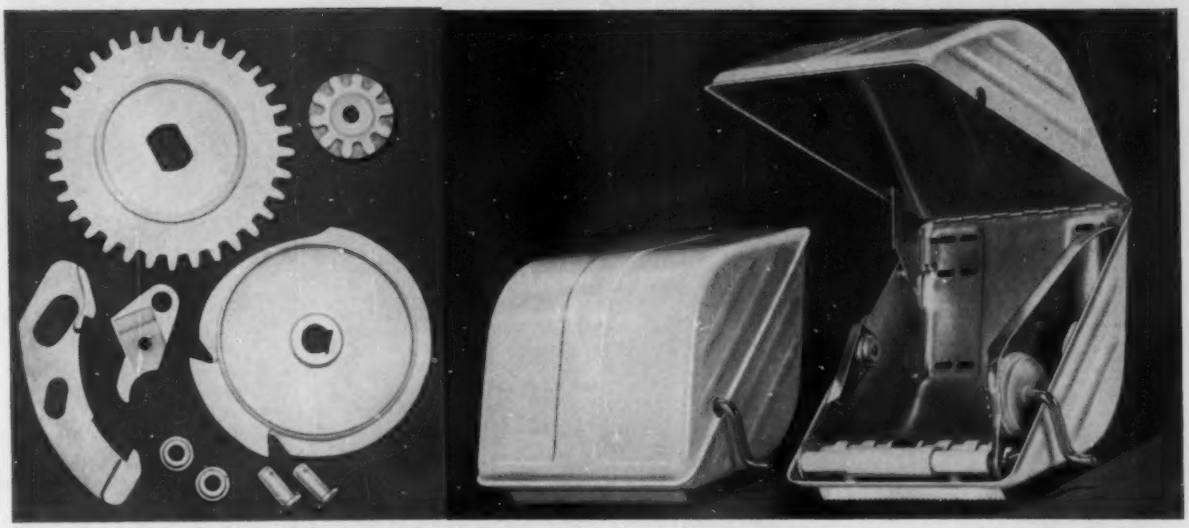
Polystyrene can be bonded to itself with a fast-setting solvent type adhesive called Logo R-703, available from Bee Chemical Co., Chicago, Ill. This adhesive is said to be essentially unaffected by high humidity and produces no frosting during use. No fixtures or clamping devices are said to be required except on very large or badly-warped parts.

Vinyl cements. Fast softening and fusing action between flexible and rigid vinyl sections or vinyl and acrylic sections can be attained with two vinyl cements developed by Schwartz Chemical Co., Inc., Long Island City 1, N. Y. Designated as VC-1 and VC-2, the cements are water white formulations. VC-1 is free flowing to make it particularly suitable for soak method application by felt pad contact in shallow pans. Type VC-2 is heavy-bodied for simple brush use in the joining of flexible vinyls, including those with irregular shapes. Both types are supplied in tubes for patch kits for flexible vinyl products.

The company has also introduced a clear vinyl-base general-purpose adhesive called Rez-N-Glue, which is said to provide a high degree of adhesion between dissimilar plastics, and of plastics to non-plastics through non-crystallizing, permanent, flexible bond. It can be used as a wet bonding agent, contact cement, or by the reactivation technique. This adhesive is supplied in 3-oz. tubes with nozzle tips; 1-qt., 1-gal., 5-gal., and 55-gal. quantities.

Flocking on plastics, rubber, and other difficult-to-adhere surfaces is possible with Rubba-Flock, manufactured by Rubba, Inc., New York, N. Y. This is said to be permanently flexible and will withstand **(To page 249)**

New ideas in NYLON



The use of nine Spencer Nylon parts instead of metal cut a pound from the weight of this Towlsaver paper towel dispenser. The parts are molded for Towlsaver by American Molding Co., San Leandro.

Spencer Nylon Gears Outwear Metal, Cut Product Weight, End Gear Noise

How Towlsaver, Inc., of Los Angeles produces a lighter, more quiet, trouble-free dispenser with parts molded from Spencer Nylon:

The moving parts in a paper towel dispenser must be able to take a lot of punishment. That's why Towlsaver, Inc., of 2639 South Garfield, Los Angeles, recently set out to find a better material to replace the metal gears in the Towlsaver dispenser. The metal gears, although case hardened, would eventually wear, and also were rather noisy.

The solution to this problem was found in tough, lightweight Spencer Nylon. The Towlsaver dispenser now contains nine parts molded from Spencer Nylon by the American Molding Co., 2002 Davis St., San Leandro, Calif.

"We are very pleased with the improvement in our dispenser since changing to nylon," reports Jack L. Perrin, president of Towlsaver, Inc. "By using nylon for these parts we have a virtually silent cabinet, and we have not experienced any gear failure because of wear. Also, the substitution of nylon has reduced the overall weight of our dispenser approximately one pound, which is an important freight saving."

There are important processing advantages, too, in Spencer Nylon. For one thing, Spencer Nylon contains far less water than other type nylons . . . saves you money because you don't have to dry it. Also, no other type nylon has the "body" needed for complicated shape extrusions.

It's easy to see why so many companies are switching to Spencer Nylon. For more information, contact Spencer's West Coast Sales Office, 1435 South LaCienega, Los Angeles.

SPENCER®

SPENCER CHEMICAL COMPANY

SPENCER NYLON

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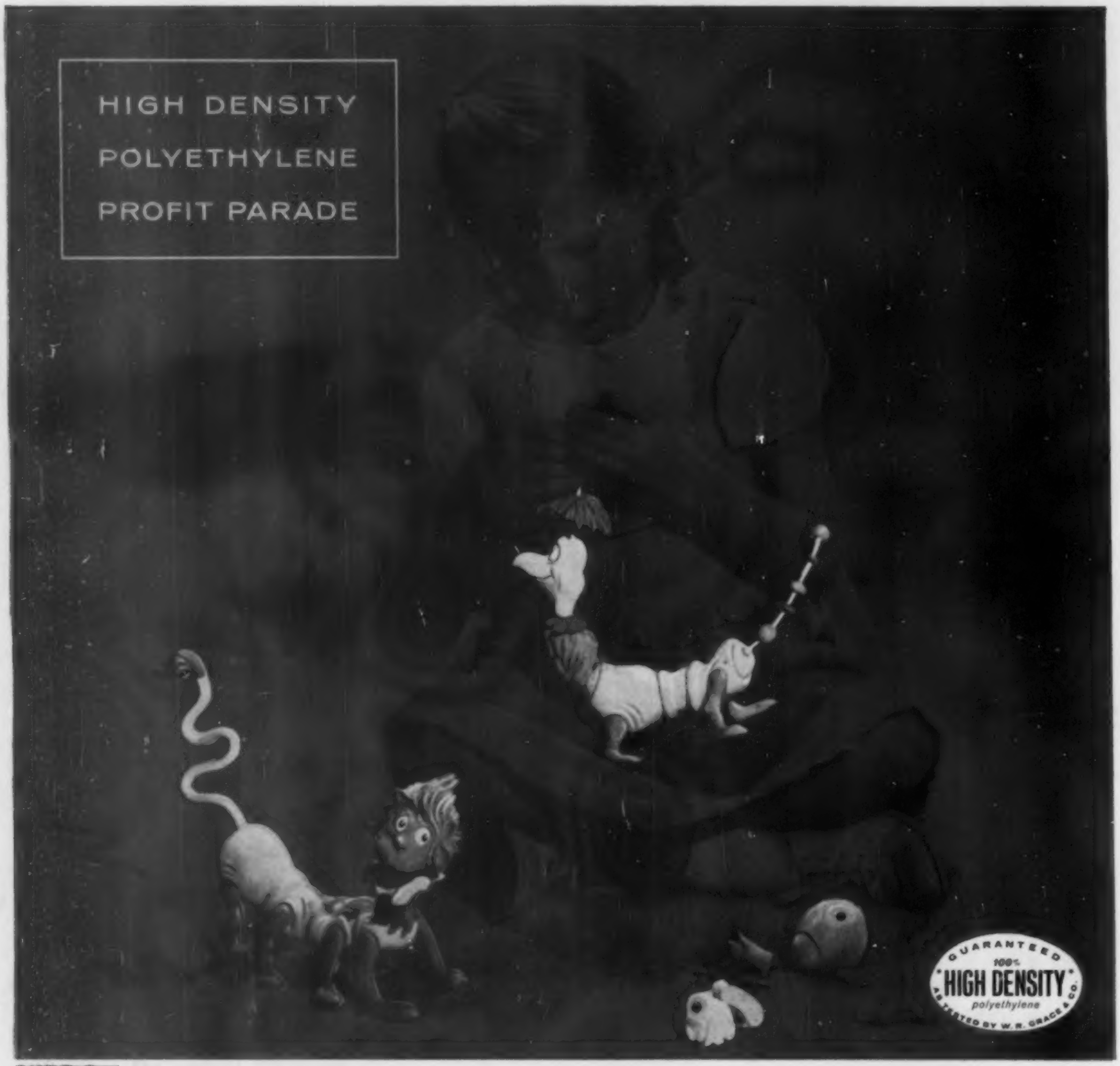

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Play-proof Properties Spark New Product Idea

Developing a new product? Grex high density polyethylene could stir up as much excitement for you as it's doing for Revell, Inc. Their new product combines the toughness of Grex with the appeal of fantastic animal characters that roam the pages of Dr. Seuss' juvenile books. Sold in kits of interchangeable parts, Dr. Seuss Zoo inhabitants snap together and pull apart in millions of ways—are colorful and strong enough to take the roughest treatment without breaking, chipping or cracking.

There is virtually no limit to profitable new product applications with this versatile Grace plastic. Here are just a few of its advantages: It can be fabricated at low cost and molded in any color. It is a hard, stiff, rugged thermoplastic that takes boiling or freezing without losing its shape or strength.

Find out more about high density polyethylene for the new product you have in mind by calling in the experts. Grace has the production facilities, technical service and experience to help put your product in the Grex profit parade. We're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

W. R. GRACE & CO.
POLYMER CHEMICALS DIVISION
CLIFTON, NEW JERSEY

THE PLASTISCOPE

(From page 246)

shock and extreme changes in temperature. It can be applied by brush, machine, or spray, and is available in 1- and 5-gal. containers and 55-gal. drums.

Labeling of PE containers can be accomplished with Rubbatex polyethylene adhesive developed by Rubba, Inc. This adhesive is said to form a permanent, flexible bond with all PE surfaces, and may be brushed, sprayed or applied by conventional labeling machines, to both flexible squeeze bottles and semi-flexible PE containers. The company has also developed an improved packaging adhesive, designed especially to bond seams and bottom flaps of polyethylene-lined kraft or burlap bags and other containers.

The new material is said to form a strong permanent bond with PE that is impervious to extreme changes in temperature. It is said to be a shock-resistant, flexible, non-crystallizing adhesive with good aging qualities. Because of the grabbing ability, it is suitable for high speed production, the company states.

Laminating Mylar to resin-impregnated asbestos, kraft, and rag papers, bonding fabrics and papers, and similar electrical insulating materials is said to be possible with a strong, flexible, solvent-resistant adhesive, designated Bondmaster L-379, available from Rubber & Asbestos Corp., Bloomfield, N. J. Laminations made with this material are used as phase and layer insulations in electric motors, generators, and transformers.

Adhesive pre-forms. Die-cut or pre-formed shapes of dry adhesive film for laminating copper to phenolic board, printed circuit construction, and for similar applications has been introduced by The Auburn Mfg. Co., Middletown, Conn. Feature of the new adhesive is its paper interliner, which permits accurate die-cutting or preforming. The 2-mil film has a visible effective adhesive layer that permits control of the amount for each **(To page 250)**

THE PLASTISCOPE

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joint. According to the company, this film provides uniformity of thickness at the glue line. Operating costs are said to be reduced by eliminating the clean up time, allowing more selective inventories, and avoidance of production line waste. Optimum application conditions include a glue line temperature from 325 to 350° F., and pressure from 100 to 2000 p.s.i.

New companies

Plastic Corp. of Arizona, 1248 S. 26th Place, Phoenix, Ariz., was formed to manufacture PE and cellophane bags, and will also act as consultants for transparent flexible film packaging.

James A. Decker is president; **William E. Demand,** vice-president in charge of sales; and **Dana E. Myers,** plant manager.

Elmer Plastic Fabrics Corp., 161-24 Northern Blvd., Flushing, N. Y., is a new company that will act as distributor and converter of vinyl film and sheeting. The company will also sell custom-made vinyl and polyethylene extrusions, such as laces, welting, and small tubing.

Royell, Inc., 927 Industrial Ave., Palo Alto, Calif., is a new raw materials distributor to the reinforced plastics industry, and will handle glass fiber cloth, mat and roving; polyester and epoxy resins; mold releases; catalysts; pigments; gel coats; etc. **Roy E. Theiss** is president and **Robert Elliott,** vice-president.

Micron Chemical Products Corp., 740 Court St., Brooklyn, N. Y., entered the vinyl foam field. The company manufactures chemically blown open cell foam slab stock in various colors, in sizes up to 54 by 96 in., and in 6.5 and 5.5 lb./cu. ft. densities. Micron will concentrate on foam markets for heat-sealing applications.

Expansion

Amoco Chemicals Corp. has started construction on a semi-commercial plant to produce multi-million pound quantities of trimellitic anhydride which the company first introduced in development quantities less than a year ago.

A promising application for trimellitic anhydride is as a curing agent for epoxy resins. It is also a chemical intermediate and a raw material for the production of long-oil alkyd resins, unsaturated polyesters, and thermosetting adhesives.

Du Pont is building new laboratory and office facilities for its Mylar polyester film technical section adjoining its Circleville, Ohio, plant where Mylar is presently being manufactured.

Glamorgan Pipe & Foundry Co., Lynchburg, Va., has entered the plastics pipe field with a new extrusion plant to produce rigid PVC pipe. The company established a plastics division, and appointed **William E. Enright,** formerly western division sales manager for Pyramid Industries Inc., Erie, Pa., sales director for the new line of pipe.

The general sales office will be located in Lynchburg, with district sales offices in New York, N. Y., and Chicago, Ill. Chief Engineer **Armistead Long, Jr.,** will supervise the extrusion plant, which includes research and development facilities for plastics pipe extrusion.

Plastic Horizons, Inc. has established a new plant at Batavia, Ill., for the production of polyethylene film. The facility, which is expected to go on stream this month, will occupy 27,000 sq. feet. Both PE flat film and tubing, up to 60 in. wide, will be produced.

The company was established in New Jersey six years ago, and in the first year of business produced less than 1 million lb. of film. Expansion in the eastern plant, plus the added capacity at Batavia, is expected to push production to 10 million pounds.

Taylor Fibre Co. has more than tripled the space for basic research in vulcanized fibre and laminated plastics, including special studies of applications in aircraft, missile, **(To page 252)**

"...*nothing but the finest plasticizers in our outwear materials*"

Harte's WATASEAL

Fred S. Strauss, President of Harte & Company, New York, says:

"My main goal in business is to make a good product and a reasonable profit. To accomplish this, we use only the best of plasticizers. Obviously, if we could reduce the cost of our raw materials, we could probably show a better profit, but what would happen to our product and our fine reputation for quality merchandise?

"When it comes to outerwear, it is no secret that vinyl fabrics must possess low temperature flexibility and the plasticizers we use for that product must give us this important characteristic and meet the strictest of specifications. Since we have a big stake in the future of the outerwear industry which we do not wish to jeopardize, we must never compromise on the quality and the performance of the raw materials we use."

Where the accent's on quality there's a preference for **Plastolein® Plasticizers**

Emery

Organic Chemical Sales Department

EMERY INDUSTRIES, INC., CAREW TOWER, CINCINNATI 2, O.

Vopcolene Division, Los Angles; Emery Industries (Canada), London, Ont.
Export Department, Cincinnati

THE PLASTISCOPE

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nuclear energy, and other fields, at temperatures up to 1000° F. The increased facilities are at its new research center on the company's main plant site at Betzwood, near Norristown, Pa.

S.p.A. Celene, the Sicilian company owned jointly by **Union Carbide Corp.** and **Societa Edison,** Milan, Italy, will double its polyethylene capacity to 60 million lb. per year. The additional facilities will be located at Celene's PE plant now under construction at Priolo, Sicily.

Celene will also expand its petrochemical activities to include production of ethanol, butanol, and 2-ethyl-hexanol, as well as ethanolamines.

Borden Chemical Co. has completed a half-million-dollar plant in Illiopolis, Ill., for the Coatings & Adhesives Dept. The facility, with 24,000 sq. ft. of floor space, adjoins the company's existing installations for the manufacture of PVAc, PVC, and butadiene-styrene emulsions.

Aeroplastics Corp., custom molders of expandable polystyrene, has moved from El Segundo, Calif., to larger facilties at Venice, Calif. The new building will be used for the production of the company's Magikeeper food keeper, and the Swim Fun board, as well as for custom molding packages, displays, and a new line of products.

Plastic Molders Supply Co., Fanwood, N. J., has opened a new plant at Norwalk, Ohio, which increases the company's capacity for coloring thermoplastics powder from 50 million to more than 100 million lb. of material annually. **A. K. Van Cleef,** vice-president of **PMS of Ohio, Inc.,** is in charge of the new offices, plant, and warehouse.

Franklin Plastics, Inc., Franklin, Pa., manufacturers of Dur-X plastic pipe and fittings, has purchased **Gulfstream Plastics, Inc.,** Hialeah, Fla. Operating personnel will be **Dixon P. Downey,** presi-

dent; **Robert J. Litzinger,** vice-president and resident general manager. **Charles W. Mitchell** will continue as sales manager.

Gulfstream will be operated as a wholly-owned subsidiary of Franklin, and will continue its activities in the custom injection molding field and will also make some Dur-X plastic pipe fittings.

Colorite Plastics of New Jersey, Inc., Paterson, N. J., manufacturers of garden hose, sprinklers, and other consumer items, has added a 15,000-sq.-ft. building to the present factory area, as part of its program for the expansion of production and research facilities. Compounding facilities are being provided, and a wide range of compounds will be marketed by the company's **Unichem Products Division.** Current research and development facilities are being centralized and a new laboratory will be added.

Action Plastics, another division of Colorite, has recently expanded its custom extrusion facilities by adding machinery.

Canadian Industries Ltd. has doubled the capacity of its Edmonton, Alberta, Canada, PE plant to 40 million lb. a year.

Spencer Chemical Co. plans to construct a new building at its research center, Kansas City, Mo., to house its Process Development Dept. The new structure will have approximately 11,000 sq. ft. of floor space. Completion is estimated for early in 1960.

Industrial Nucleonics Corp. has moved into a new 75,000-sq.-ft. plant at 650 Ackerman Rd., Columbus, Ohio. The new facility comprises approximately one-fifth of a projected research manufacturing center. The company's AccuRay process control systems are used for continually measuring and controlling the thickness of plastics films.

Reichhold Chemicals, Inc. has been rejoined by **Beckacite Resin Ltd.,** Vienna, Austria, which has been converted into a publicly owned company under the name of **Reichhold-Beckacite A.G.** This makes 19 for- **(To page 254)**

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EDITOR,

MODERN PLASTICS ENCYCLOPEDIA ISSUE

575 Madison Ave., New York 22, N.Y.

THE PLASTISCOPE

(From page 253)

eign countries in which RCI has affiliated or associated companies producing the firm's line of basic chemicals, synthetic resins, and other products.

The company's new half-million-dollar formaldehyde plant at Kansas City, Kan., has gone on stream. Capacity of the new facility is 30 million lb. per year.

Chemo Products, Inc., West Warwick, R. I., producers of molded fluorocarbon products, insulation tapes, and coated yarns, has added facilities for machining and fabricating. The new department is machining a wide variety of parts and shapes from compression moldings.

National Starch & Chemical Co. (Canada) Ltd. has started production at its newly completed vinyl emulsion polymerization plant at Toronto, Ont. Initially the new plant will produce vinyl copolymers and homopolymers in emulsion form.

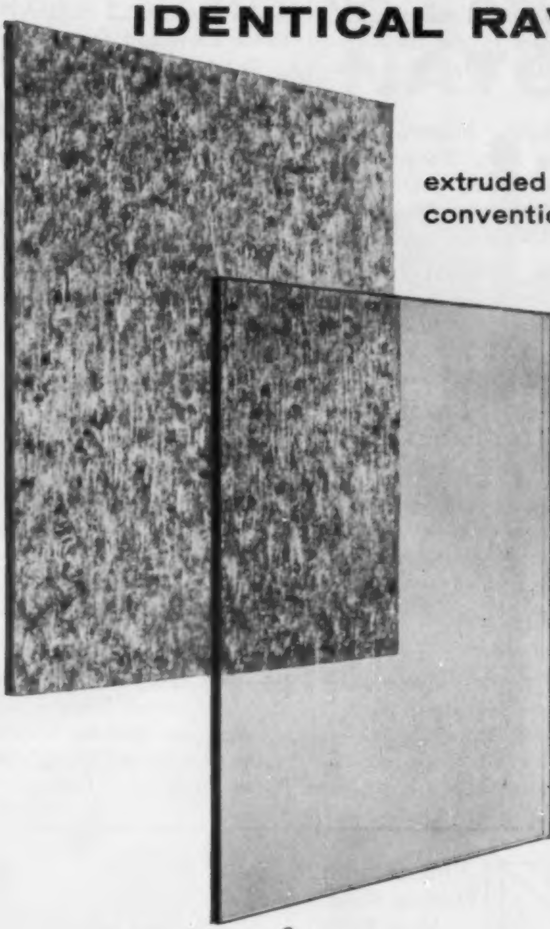
Fome-Cor Corp. began full-scale production at its Addyston, Ohio, plant. Fome-Cor is a lightweight polystyrene foam and paper sandwich material used for specialty containers, displays, and other applications. A continuous process turns out panels up to 72 in. wide and in several thicknesses and a range of densities.

The company, formed earlier this year by **St. Regis Paper Co.** and **Monsanto Chemical Co.,** also operates a semi-commercial plant at Mt. Wolf, Pa.

Dynatron Corp. has completed a new manufacturing plant at Miami, Fla., to supply DC-3 plastic filler for auto-body maintenance work and DC-3 repair kits for specialized applications. The 10,000-sq.-ft. building houses the company's main offices, complete production facilities, and a new testing and research laboratory.

Robinson Technical Products, Inc., Teterboro, N. J., has acquired **High Vacuum Equipment Corp.,** Hingham, Mass., which will be operated as a sub- **(To page 256)**

IDENTICAL RAW MATERIAL...



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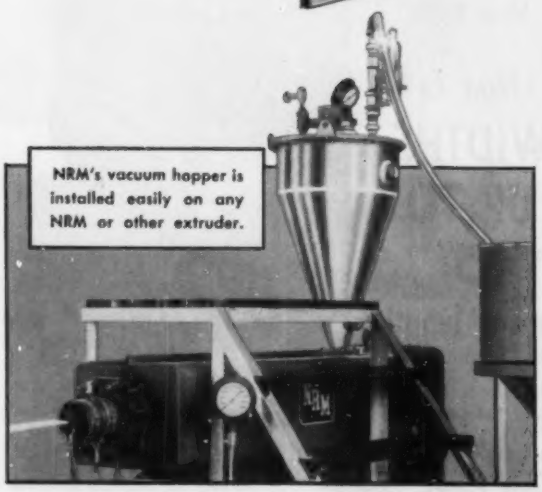
conventional equipment

NRM's vacuum hopper makes the difference!

using NRM's
new vacuum process



NRM's vacuum hopper is installed easily on any NRM or other extruder.

"The results are near-miraculous!" That's what users are saying about NRM's new vacuum hopper.

By removing air, moisture and other volatiles from plastic materials that normally require extensive pre-drying before they are fed into the extruder, NRM's vacuum hopper permits production of bubble-free extrusions from hitherto almost unmanageable materials.

Perhaps vacuum processing*, another NRM pioneering development, is the solution to your production problems. Contact NRM for complete information.

*Patent applied for.

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WEST: Hans E. Buecken Co., P. O. Box 65, Pico Rivera, Calif.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Park Ave. South, New York, N. Y.

2157-A

THE PLASTISCOPE

(From page 254)

sidiary of Robinson. The management of High Vacuum will remain unchanged.

Deceased

Edwin Stein, 64, chairman of the board, **Stein Hall & Co., Inc.,** died August 31. He was elected president of Stein Hall & Co. in 1944, and became chairman in 1948. In 1950 Mr. Stein was appointed a consultant for the adhesives industry to the Plastics Branch of the National Production Authority's Chemical Division.

Meetings

Plastic groups

Oct. 20: The Society of the Plastics Industry, Inc. (S.P.I.), Western Section, Tooling Div., "Users Panel," Roger Young Auditorium, 936 W. Washington Blvd., Los Angeles, Calif.

Nov. 4: Society of Plastics Engineers (S.P.E.), St. Louis Section, Retec "Plastics in the Shoe Industry," Statler Hotel, St. Louis, Mo.

Nov. 17: S.P.I., Western Section, Tooling Div., "Formulators Panel," Roger Young Auditorium, 936 W. Washington Blvd., Los Angeles, Calif.

Nov. 19, 20: (British) Plastics Institute, "The Influence of Plastics in Building," Royal Institute of British Architects, 66 Portland Pl., London W.1, England.

Nov. 19: S.P.E., Golden Gate Section, Retec "Plastics in Packaging," San Francisco, Calif.

Dec. 1: S.P.E., Washington-Baltimore Section, in cooperation with the Deterioration Center, National Academy of Science, Washington, D. C.

Other meetings

Oct. 20-22: National Association of Corrosion Engineers, North Central Region, 4th Annual Regional Meeting, afternoon session Oct. 20, "Materials of Construction — Plastics," Statler-Hilton Hotel, Cleveland, Ohio.

Nov. 2-5: The Metallurgical Society of American Institute of Mining, Metallurgical, and Petroleum Engineers, Fall Meeting, morning session Nov. 3, on nonmetals, including "Mechanical Properties of Polymeric Materials."

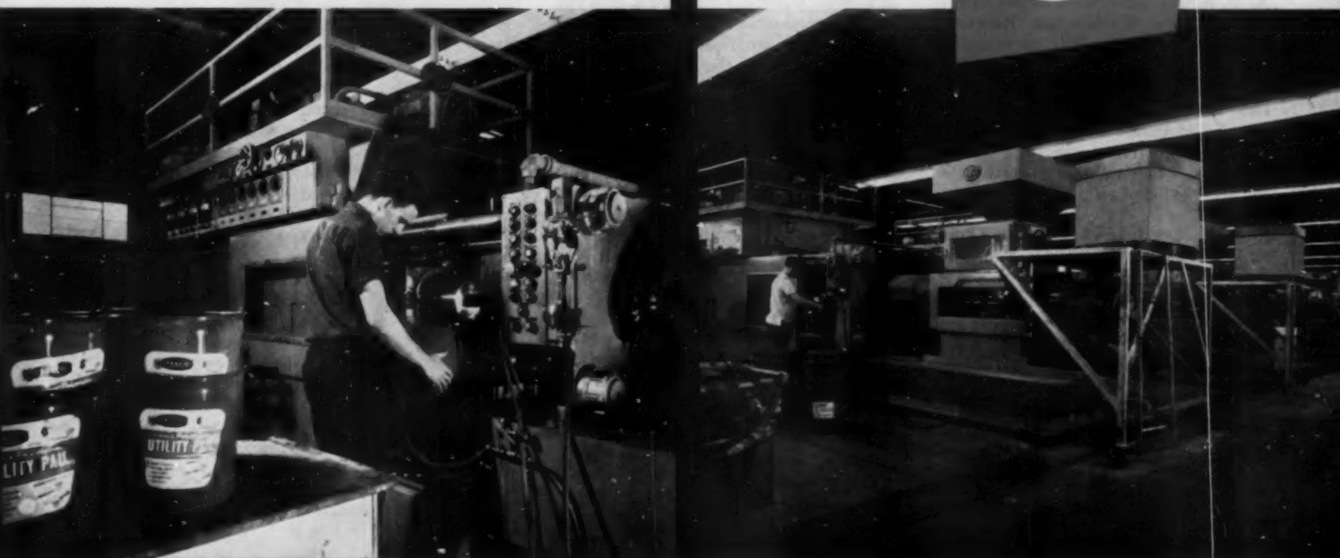
Nov. 16-19: Building Research Institute, Fall Meet, "Curtain Walls, Sandwich Panels," including workshop on "Sandwich Panel Design Criteria," Shoreham Hotel, Washington, D. C.

Nov. 17-20: Packaging Machinery Manufacturers Institute, "PMMI Show 1959," Coliseum, New York, N. Y.

Nov. 30-Dec. 4: 27th Exposition of Chemical Industries, Coliseum, New York, N. Y.

Dec. 3-5: American Chemical Society, Southwest Regional Meeting. Symposia include "Polymerization Chemistry," Capitol House, Baton Rouge, La.—**End**

FEDERAL ENAMELING & STAMPING INSTALLS 8 NEW NATCO'S



These photographs show a few of the Natco injection molding machines in the new Federal Enameling and Stamping Plant in Pittsburgh, Pa. Natco's overhead power unit makes this ideal floor layout possible.

Natco Machines Satisfy The Demand For High Production With Unsurpassed Reliability

Your profits depend upon the efficiency of your equipment . . . and to be efficient, your machines must be FAST and DEPENDABLE. Consider the following features found on Natco machines.

- The exclusive patented closed-circuit hydraulic system not only assures extremely smooth machine operation but also greatly simplifies the piping and valving required.
- Rapid clamp action and high injection speeds make fast molding cycles possible.
- Two speed injection and dual pressure controls help produce strain free parts.
- Precision controls are provided for temperature, injection pressure and filling speed.
- Lots of daylight and stroke on the straight hydraulic clamp for molding deep parts.
- Leakproof big capacity heating chambers with excellent flow characteristics insure fast cycles.

All of these advantages add up to faster molding cycles and real dependability . . . and more profits for you.

Send for Bulletin #2001 for complete information.

NATCO

THE MOLDER'S MOLDING MACHINE

NATIONAL AUTOMATIC TOOL COMPANY, INC.
PLASTIC MACHINERY DIVISION
RICHMOND, INDIANA, U. S. A.

COMPANIES . . . PEOPLE

Appointments, promotions, and relocations in the plastics industry.

W. R. Grace & Co., Research Div.: Drs. Fred Jaffe, Clifton L. Kehr, and **A. D. Ketley** have been added to the staff of the **Washington Research Center**, Clarksville, Md., as research chemists. They will be primarily concerned with polyolefin research. **Drs. Robert W. Penn** and **Louis L. Wood** also joined the div.

Richard L. Moore appointed to the new position of mgr.—chemical PR for all eight chemical divs.

U. S. Rubber Co., Footwear & General Products Div.: Charles H. Baldwin appointed gen. sales mgr. of mfrs. products which include Naugahyde vinyl upholstery, Royalite plastics products, and Ensolite vinyl sponge. He is succeeded as sales mgr.—Koylon foam seating by **Thomas R. Grimes**, who was sales mgr.—Royalite products and Flotofoam. **George H. Callum**, who previously held Mr. Baldwin's new post, is now development mgr. of the div.

Fred R. Piermattei named commodity sales mgr. of the newly-formed Royalene yarn dept. Royalene is the company's tradename for its line of polyethylene and polypropylene fibers. Headquarters of the dept. is at Providence, R. I.

Goodyear Tire & Rubber Co.—Chemical Div.: L. P. Thies, former head of the Detroit, Mich., office, is now mgr.—Polyester Products Dept., and **W. E. Kelly**, previously mgr. of the St. Louis, Mo., office, now heads the Adhesives Dept. Both depts. are newly-established. **L. E. Stanton** replaces Mr. Thies, and **J. Platner** succeeds Mr. Stanton as dist. mgr. at Houston, Texas. **J. D. Hunter** succeeds Mr. Kelly as dist. mgr. at St. Louis. **R. W. Williams** promoted from sr. sales rep. to dist. mgr. on the West Coast.

Film & Flooring Div.: C. E. Hixson, Dallas, Texas, dist. mgr., moved, in the same capacity, to Chicago, Ill. He is succeeded by **P. E. Mulvehill.**

Koppers Co., Inc., Plastics Div.: Andrew A. Sellers, formerly mgr.—operations, appointed mgr.—engineering. **Wallace K. Todd**, previously mgr. of Kobuta Plant, Monaca, Pa., now mgr.—production. He is succeeded by **Charles D. Burton**, formerly mgr.—industrial relations.

Allied Chemical Corp.: Dr. Harry H. Weinstock, Jr., named asst. mgr. of research at the firm's **Central Research Laboratory**, Morristown, N. J.

National Aniline Div. organized a new marketing program for isocyanates and promoted **John J. Reed** from product mgr.—isocyanates, to mgr.—isocyanates market development. He is succeeded by **J. W. Hull.** Mr. Reed's group will assist customers with technical problems related to the production of new urethane products and applications. **Dr. M. E. Bailey** will direct the technical service group which is located in Buffalo, N. Y. **Edwin M. Williams, Jr.**, named sales rep., Greensboro, N. C. area.

Plastics & Coal Chemicals Div.: David W. Towler joins as Plaskon molding compounds sales rep. for the western New England area.

Solvay Process Div.: M. James Campbell named asst. to the VP. **Robert E. James** made mgr. of the Moundsville, W. Va., operations.

Ciba Products Corp.: M. M. Gruber, formerly head of coatings resins sales, appointed sales mgr. **Elliott N. Dorman**, previously head of structural resins sales, now tech. sales mgr. **Richard H. Malamphy** joins as mgr. for new products. He was formerly sales mgr. for Swedlow (Plastics) Inc., Los Angeles, Calif., and Naugatuck Chemical Div., U. S. Rubber Co.

Gruber Dorman Malamphy

Tennessee Eastman Co., div. of **Eastman Kodak Co.: Dr. Ben P. Rouse, Jr.**, appointed chief chemist, Tenite development dept.; **James G. Stranch, Jr.**, named sr. chemist in charge of the plastics laboratory; **Thomas M. Hearst** appointed chemist in charge of the physical testing section of the plastics laboratory.

Monsanto Chemical Co., Plastics Div.: Lincoln B. Crosby promoted from mgr. of the Springfield, Mass., plant to dir.—mfg., eastern operations for the div. He replaces **Carl E. Pfeifer**, who has been given an extended leave of absence to accept a special assignment at St. Louis, Mo., for the exec. committee. **Allen G. Erdman**, formerly administrator for vinyl products, appointed plant mgr. at Springfield.

In the engineering dept. at Springfield, **Alfred W. Andrews**, asst. dir. of engineering, assigned additional responsibility for overall departmental and divisional engineering relationships, as well as the development, planning and plastics engineering groups. **Robert K. Dimmitt**, formerly mgr.—development engineering, is now asst. dir. of engineering. He is succeeded by **Samuel J. Starker. James A. Mack** and **Henry R. Maichle** joined the dept.

Also at Springfield, **Luigi A. Contini**, previously mgr.—design R & D, named market specialist, packaging. **Edmond S. Bauer** promoted from a development dept. assoc. to asst. dir. of development, responsible for products resulting from the company's research, but not directly assigned to the div.'s marketing dept.

Michael J. Friedman, Lauren R. Davis, and **William S. Gross** joined the prod. dept. **Virginia L. Lyons, Mary L. Gover,** and **Herbert J. Olson** are new members of the research dept. **Gerald S. Goldberg** joined the Lustrex dept. and **Robert J. Sexe** is now with the sales dept. at Springfield.

At Texas City, Texas, **Clem K. Best, Jr.**, and **Doyle R. Wise** joined the mfg. dept. **Carl M. Cruse** and **James B. Spradling** are new members of the research dept., and **Charles E. Hill, Jr.**, joined the engineering dept.

Marbon Chemical Div., Borg-Warner Corp.: J. R. Corbin appointed sales service mgr. **J. H. LaFollette**, previously with U. S. Rubber Co., joined as sales service engineer. **John S. Saviello** named tech. sales rep. for the Eastern Seaboard area.

B. F. Goodrich Co.: Dr. Louis E. Trapasso, Frank Donat, and **Charlotte Kraebel** joined the chemical and plastics research dept. at the Brecksville, Ohio, center.

B. F. Goodrich Chemical Co.: Grant E. Stueber, formerly a development supv. is now mgr.—chemical process development at the Avon Lake, Ohio, development center.

Howard G. Womack heads the newly-established sales office in The Hague, Netherlands, which will be European sales headquarters for plastics materials, special-purpose rubber, and general chemicals.

B. F. Goodrich Industrial Products Co.: Jesse M. Hawkins named N. Y. dist. sales mgr. He succeeds **John M. Failey**, who retired. **Earl E. Hecker** appointed Chicago, Ill., field sales rep. for coated fabrics made by the company's Plastics Products Div.

Borden Chemical Co., Polyco-Monomer Dept.: Maurice S. Letourneau appointed metropolitan N. Y. dist. sales mgr. **Arthur A. Coffin,** a specialist in paper chemistry, recently retired from the Titanium Pigment Corp., now a consultant for Borden.

Coatings & Adhesives Dept.: Thomas P. Fitzpatrick appointed Midwest dist. sales mgr. He will also be responsible for **(To page 260)**

COMPANIES...PEOPLE

(From page 258)

the company's Chicago plant until those facilities are moved later this year to Illiopolis, Ill.

Bruce S. Galbraith named asst. gen. mgr. of **Alba S. A.**, the company's Brazilian organization, which operates methanol, formaldehyde, synthetic resin, phenolic molding compound, and polyester plants.

Hooker Chemical Corp.: Dr. John J. Kolano and **Noel D. Blair** have been added to the plastics research group of the company's research dept. on Grand Island, N. Y.

Dr. Frank W. Long and **W. Eric Ashton** appointed project supvs. in the product development section of the research dept.

New England Laminates Co., Inc., Stamford, Conn.: **John Baker** named gen. plant mgr. **Norman E. Shenk** is production coordinator. **Edward J. Svee, Jr.**, former asst. to the sales mgr., becomes a tech. sales engineer and will be located at 374 Baxter St., Medina, Ohio. He is succeeded by **Harold L. Stephens.**

Godfrey L. Cabot, Inc.: Dr. Thomas H. Goodgame rejoined as chemical engineer in process and engineering section of new products research dept. after being an assoc. professor at Georgia Institute of Technology.

Samuel B. Coco, Jr., of the company's Akron, Ohio, sales office, transfers to Boston, Mass., office as adm. asst. to director of sales. **George P. McGonigle, Jr.**, transfers from Boston to Chicago, Ill., office and **William J. McNeil** moved from the Cambridge, Mass., research laboratories to the Boston office as sales asst. **Joseph P. Hall, Jr.**, succeeds Mr. McNeil as group leader in special blacks tech. service.

Charles I. Tewksbury joined the organic polymer research section of new products div. at Cambridge.

Foster Grant Co., Inc.: William J. Rainey, formerly supt. of the quality control laboratory of Celanese Corp., appointed mgr.—styrene prod. control laboratory for the company's Polymer Products Div. **Edwin E. Kasha**, formerly chief colorist for Koppers Co., named head of the color development laboratories. **Arthur Alix** joined the Plastics Sales Div. as a rep. in the Midwest area.

Plastic Age Aircraft Corp. and **Plastic Age Reinforced Products** merged into **Plastic Age Mfg. Co.** Each of the merged divs. will retain its operating identity. The new company, located in Mint Canyon, Calif., will carry out the bulk of the mfg. operations including molding, forming, and lamination of many acrylic and reinforced plastic materials.

Mobay Chemical Co.: Jack E. Steiner assigned to Akron, Ohio, dist. sales office. **Daniel V. Pompilio** appointed to eastern sales dist. with headquarters in New York, N. Y.

DeWitt Plastics is the new name of **Bill DeWitt Div. of Shoe Form Co., Inc.**, Auburn, N. Y., to reflect the company's concentration in the plastics industry.

Thermatron, div. of **Willcox & Gibbs Sewing Machine Co.: Dick Sperr** named to head Los Angeles, Calif., office. **Bill Principe** will take charge of Atlanta, Ga., office.

Lenox Plastics, Inc.: J. Robert S. Conybeare promoted from gen. sales mgr. to VP—sales. **Paul V. McConnell** appointed eastern sales mgr.

Rubber & Asbestos Corp. opened a Midwest area sales office at 3553 W. Peterson Ave., Chicago 45, Ill. **Stewart Marshall** transferred from N. J. office to Chicago.

National Polychemicals, Inc., Wilmington, Mass.: **Alexander Freeman** and **William Homer, Jr.**, joined the firm's Development Dept. and will be active in the re- (To page 262)

Latest Addition
TO THE WORLD FAMOUS RANGE OF
WINDSOR
PLASTICS MACHINERY
AP16
FULLY AUTOMATIC
INJECTION MOULDING MACHINE
WITH SINGLE-SCREW PREPLASTICISER
This latest addition to the world famous range of Windsor Injection Moulding Machines is completely automatic in operation and embodies a single-screw pre-plasticiser with a plasticising capacity of up to 100 lb. per hour. It has been designed to produce high quality, stress-free mouldings up to 14 oz. shot weight
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LAND London Office: 76 JERMYN ST., ST. JAMES'S

COMPANIES . . . PEOPLE

(From page 260)

cently formed Plastics Div. The company produces phenol and urea formaldehyde resins.

Cadillac Plastic & Chemical Co. opened a sales office at 54 W. 30 St., Indianapolis, Ind., headed by **Robert Brinkers**, formerly at the company's Cincinnati, Ohio, branch. The company also established a sales office at 39 S. Main St., Akron, Ohio, and appointed **Philip Rath** rep.

Federal Tool Corp.: Efrem Ostrowsky named plant mgr. and chief engineer; **Myron Petrakis** moves up from supt. of the vacuum forming dept. to supt. of the fabricating dept.

Polyvinyl Chemicals, Inc. opened sales offices at 274 Madison Ave., New York, N. Y. **Joseph E. Conklin** appointed mgr.

Consolidated Vacuum Corp. is the new name of the **Rochester Div.** of **Consolidated Electrodynamics Corp.** The div. produces high-vacuum and environmental test equipment.

Philip S. Fogg was elected chrmn. and **Frank M. Jenner** is pres. of the wholly-owned subsidiary of CEC.

Wyandotte Chemicals Corp., Research Div.: Dr. Phelps Trix, former mgr.—market development dept. named dir.—product development. **Dr. Kurt C. Frisch** appointed dir.—polymer research. **John Worrell,** formerly mgr.—PR, returns to the research div.

Foamade Industries, 14851 W. Eleven Mile Rd., Oak Park, Mich., now supplies urethane foam self-adhesive tape in various colors, lengths, and widths for industrial uses.

Polysyn, Inc., subsidiary of **Poly Industries, Inc.,** Pacoima, Calif., now supplies stock shapes of Teflon rod, tube, sheet, and tape; Kel-F in disk form; and also a range of polyvinyl chloride products.

Catalin Corp. of America: Edward C. Betts named head of the acrylic resin section; **William R. Sterr** heads the powder resin section of the Fords, N. J., resin prod. dept.

Resistoflex Corp. moved its Western Div. into new and expanded facilities at Anaheim, Calif. The larger facilities permit installation of additional processing equipment for increased production of Fluoroflex-T hose and hose assemblies of Teflon for the aircraft and missile markets.

Warren G. Parmenter named mgr.—plastics section, **Walworth Co.,** New York, N. Y. He will be in charge of valves and fittings development, and assist the mgr. of **(To page 264)**

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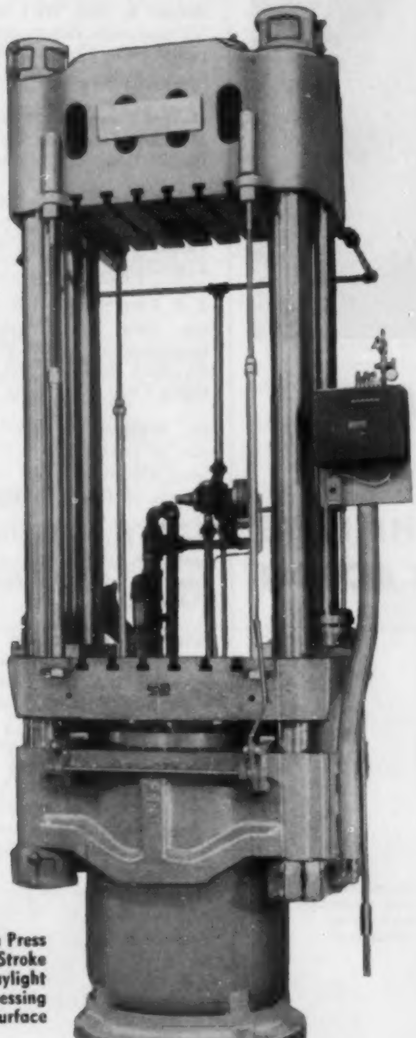
FRENCH PRESSES
Pound Costs Down With Every Stroke



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36" Stroke
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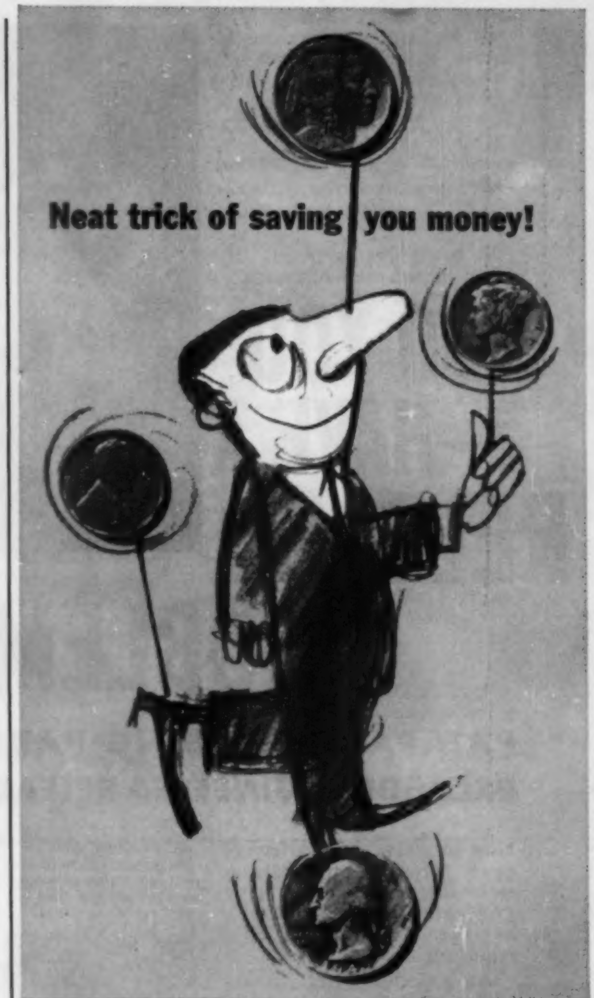

Actually, with our long experience and tremendous selection, it's no trick at all to save you money on molding powders. You get the exact formulation you need . . . . the best quality for your requirements . . . . the lowest cost. Consult our technically qualified salesmen . . . . and save!

High Impact Polystyrene
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Manufactured in all formulations in pellets or colorant blend.

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In every melt index and all densities.

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Tailor made, colored compounds for injection molding, extrusion and blow molding.

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COMPANIES . . . PEOPLE

(From page 262)

plastics sales in matters relating to industrial and municipal specifications and codes. Mr. Parmenter was previously with Permacel Tape Corp.

Alfred E. Van Wirt promoted from VP and tech. dir. to exec. VP of **Imperial Color Chemical & Paper Corp.,** Glens Falls, N. Y.

George Dingman appointed gen, mgr. of **Chippewa Plastics Co.,** div. of **Rexall Drug & Chemical Co.**

Rudolph W. Kugler named asst. to **George F. Blasius,** pres. of **Cary Chemicals, Inc.,** East Brunswick and Flemington, N. J.

J. F. Lent named dist. mgr. of western New York State sales, with headquarters at 137 W. Commercial St., East Rochester, N. Y., for **Synthane Corp.,** Oaks, Pa.

Dr. William B. Reynolds, formerly dir. of research for Phillips Petroleum Co., named VP and dir. of research of **General Mills, Inc.**

Francis J. (Frank) Myers appointed asst. dir. of marketing and product research at **Arvin Industries, Inc.,** Columbus, Ind.

Albertus Slingerland named gen. mgr. of **Spencer Chemical Co. International, Inc.,** a wholly-owned subsidiary of **Spencer Chemical Co.**

William J. Fisher transferred from Atlanta, Ga., to the metropolitan N. Y. and northern N. J. territory as a member of the field sales staff of the **Vacuum Equipment Div., F. J. Stokes Corp.,** Philadelphia, Pa.

Walter W. Bradley joined **Engineering Plastics Co.,** 45 E. Walnut St., Pasadena, Calif., thermoplastic sheet formers, as shop supt.

Lester B. Cundiff named sr. process engineer in Polyolefin Dept. of **American Viscose Corp.'s** R & D Div.

Harry Nash joined **Claremont Pigment Dispersion Corp.** as tech. sales rep. serving gravure and flexographic ink customers in the New York metropolitan area.

Allan W. Cox named dir.—urethane product sales for **The Dayton Rubber Co.,** Dayton, Ohio.

H. W. Buchanan named mgr., gen. sales dept., **Metal & Thermit Corp.,** Rahway, N. J.

Ralph M. Knight appointed a VP of **U. S. Industrial Chemicals Co., div.** of **National Distillers & Chemical Corp.** He will intensify U. S. I.'s long-range polyolefin development

program, and will continue to direct the Polymer Service Laboratory and coordinate its efforts with other plastics activities within the company.

Hans E. Buecken Co., West Coast rep. for **National Rubber Machinery Co.**, and **Industrial Mfg. Corp.**, moved from Santa Barbara to 9249 Lochinvar Dr., Pico Rivera, Calif.

Otto Hansen, formerly supv. of reinforced plastics production, Olympic Plastic Co., joined **American Alkyd Industries** as western dist. sales mgr. in charge of Amester polyester resins sales.

Willard deCamp Crater, Jr., formerly marketing dir.—Polymer Chemicals Div. of W. R. Grace & Co., named exec. VP and gen. mgr. of **American Molding Powder & Chemical Corp.**, Brooklyn 6, N. Y.

Harold F. Engler, formerly in the sales div. of **B. F. Goodrich Chemical Co.**, is now representing **Deecy Products Co.**, Cambridge, Mass., for its plasticizer and stabilizer line in the N. Y., N. J., and Pa., area. His office is 35 Addison Pl., Ho-Ho-Kus, N. J.

R. H. Strong appointed market development mgr. for **Naugatuck Chemicals**, Div. of **Dominion Rubber Co. Ltd.**, responsible for initial marketing stages of new plastics resins, agricultural chemicals, and general organic chemicals and intermediates. He will headquarter at the company's offices in Elmira, Ont., Canada.

James C. Brown joined the research staff of **Ferro Chemical**, Div., of **Ferro Corp.**, Bedford, Ohio.

Arthur A. Cornez named asst. to the pres. of **Reiss Associates, Inc.**, Lowell, Mass., mfr. of high-pressure decorative laminates.

Dr. William V. Medlin left **Shell Development Co.'s** Emeryville, Calif., research center to become tech. asst. to **Dr. Harold Gershinowitz**, pres. of the company, in New York, N. Y.

R. T. MacAllister, former decorative products mgr., elected VP of **Formica Corp.**, subsidiary of **American Cyanamid Co.**, with responsibility for sales and advertising. He succeeds **J. A. Healy**, who has been appointed asst. to the pres. of Formica and will work on special assignments at Cyanamid's New York, N. Y., office.

Robert J. Harsch appointed group leader of process development at **Diamond Alkali Co.'s** plastic research dept., Painesville, Ohio.

Harold E. Fife has joined **Lincoln Plastics Corp.**, Stamford, Conn., as mgr. of **Plastics Corp. of America**, a Lincoln subsidiary. The company is a new integrated supplier of crystal polystyrene, which is used by Lincoln in the manufacture of plastics wall tile. It will also sell general-purpose crystal polystyrene to the injection molding industry.

Helmut Fochler replaces **G. Sidney Smith** as lab. mgr. for **Carlon Products Corp.**, Aurora, Ohio.

Jack C. Heath named mgr. of sales of fluorescent coatings and pigments, **Lawter Chemicals, Inc.** He will headquarter at the Chicago, Ill. plant.

William S. Shore appointed dir. of the Plastics Div. of **Scientific-Atlanta, Inc.**, Atlanta, Ga., mfr. of plastics components for electronics and missiles and commercial products.

Charles E. Farnsworth named product mgr.—plastics, a new div. in the product management dept. of **Enjay Co., Inc.** He will be responsible for manufacturing coordination, tech. service, and transportation and distribution for the plastics div.

New reps.

Berton Plastics, Inc., 79 Fifth Ave., New York, N. Y., named a distributor for Reynolds Metals Co.'s Revlon polyvinyl alcohol film . . . **Jerome Stern**, 19 Deer Head Dr., Bound Brook, N. J., rep. in **(To page 266)**

COMPANIES . . . PEOPLE

(From page 265)

Md., Washington, D. C., and Va., for **Landers-Segal Color Co.** . . . **Seaboard Machinery Co.,** 3212 E. Olympic Blvd., Los Angeles 23, Calif., is southern Calif. sales rep. for **Hamilton Div.,** Hamilton, Ohio, of **Baldwin-Lima-Hamilton Corp.,** for its mechanical and hydraulic presses.

Insulation Mfrs. Corp., Chicago, Ill. appointed a full-line distributor for Mylar polyester film. The company has facilities for precision slitting of films and will both fabricate and distribute the film . . . **C. Withington Co., Inc.,** 47-40 Fifth St., Long Island City, N. Y., with a branch office and warehouse at 1641 Landon Ave., Jacksonville, Fla., named by **J. M. Huber Corp.** as exclusive distributor for its new series of kaolin clay extenders and Zeolex synthetic silicate to the plastics and specialty processing industries in metropolitan N. Y. and Fla. . . .

The W. F. E. Bomke Sales Co., Chicago, Ill., appointed Midwest sales rep. for **The Blane Corp.,** Canton, Mass., mfr. of vinyl compounds and vinyl color concentrates for the wire and cable industry . . . **Garan Chemical Corp.,** Alondra Blvd., Gardena, Calif., named exclusive distributor of peroxide and related products for the **Lucidol Div., Wallace & Tiernan** . . .

T. C. Ashley & Co., Inc., Boston, Mass. appointed exclusive selling agents in New England and New York for phenolic resins and molding compounds made by the **Firestone Rubber & Latex Products Co.** . . . **The Shelley Co.,** Los Angeles, Calif., named West Coast rep. by **Isocyanate Products, Inc.,** for the sale of Isofoam urethane resins and Newton urethane mixing equipment. . . .

Associated Industries, Seattle, Wash., appointed rep. for **Rogers Corp.,** Rogers, Conn., to handle its line of electronic insulation, sealing and high temperature materials in Oregon and Washington and at the Boeing Co., Wichita, Kansas. . . . **J. Douglas Martin,** 36-08 St. Paul Blvd., Rochester, N. Y., is new rep. for **Commercial Plastics & Supply Corp.** in northern N. Y. State.

Correction

"Plastics 1959. Third International Trade Fair. October 17 to 25, 1959. Düsseldorf, W. Germany" (MPl, August 1959, p. 144): The following Milan, Italy, organizations were inadvertently omitted from the classified list of exhibitors: Unione Nazionale Industrie Materie Plastiche; Resine Sintetiche Adamoli; Compagnia Continentale S.C.E.A.R.; S.A.I.R.S. S.r.l.; F.lli Menchini—Industria Termoplastica Italiana S.p.A.; and Flexa—Industria Materie Plastiche.—**End**

ENGINEERED NYLON PRODUCTS, INC.

***Reduced overall cycle time* 32%**

***and cut production costs* 25%**

with a

MOSLO

Model 75-4

FULLY AUTOMATIC

MOLDING MACHINE

Here's what they say...

2530 BY-PASS ROAD P.O. BOX 753 PHONE 4-1260 ELKHART, INDIANA

engineered nylon products, inc.

enp enp

specialists in molded nylon and thermoplastic products

Moslo Machinery Company
2442 Prospect Avenue
Cleveland, Ohio

April 1, 1959

Att: Mr. P. Sorensen

Gentlemen:

Several months ago we installed our first Moslo Model 75-4 Injection Press after a rather intensive survey of the equipment offered by various manufacturers and exhibited at the Chicago show last fall As you know, we are specialists in the molding of industrial nylon products, and we were looking for equipment that would not only afford increased production speeds but also would provide a wide range of precision controls over the molding characteristics of our products We are sure that you would be interested in knowing of the results we have been able to obtain on this equipment.

One of the most notable features of this machine has been found in the heating cylinder where we can now obtain excellent heat dispersion without over-heating the material. This improvement results in moldings which retain more strength characteristics than we have been able to obtain on our other machines, thereby providing us with definite quality improvement in our products.

The precise control possible on this cylinder, combined with other features of the machine, such as fast-acting moving platen, simplified mold set-up and reduced scrap shots, have combined to give us impressive manufacturing cost reductions -- in several cases as much as 20% and 25%. We feel that these results justify the purchase of additional equipment from you as we proceed with our planned improvement program on manufacturing facilities.

Very truly yours,
ENGINEERED NYLON PRODUCTS, INC.

William C. Holden

William C. Holden,
Vice President & General Manager

WORLD'S FINEST PLASTIC INJECTION MOLDING MACHINES

MOSLO

MACHINERY COMPANY

2442 Prospect Avenue
Cleveland 15, Ohio

In the above illustration are (left to right) Mr. Charles Stephens, Plant Superintendent, and Mr. William C. Holden, Vice President & General Manager of Engineered Nylon Products; observing their Moslo machine in operation.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of MODERN PLASTICS, published monthly at Bristol, Connecticut, for October 1, 1959.

State of New York
ss.
County of New York

Before me, Notary Public, in and for the State and County aforesaid, personally appeared Alan S. Cole, who having been duly sworn according to law, deposes and says that he is the Publisher of MODERN PLASTICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), to wit:

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Alan S. Cole, 575 Madison Ave., New York City.

Editor, Hiram McCann, 575 Madison Ave., New York City.

Managing editor, I. Gross, 575 Madison Ave., New York City.

Business manager, Stuart Siegel, 31 Tintern Lane, Scarsdale, N. Y.

2. The owner is: (If owned by a corporation, its name and address must be stated and also, immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as those of each individual member, must be given.)

Breskin Publications, Inc., 575 Madison Ave., New York, N. Y.

Charles A. Breskin, 575 Madison Ave., New York, N. Y.

Millie Breskin, 59 Park Road, Scarsdale, N. Y.

Linda Klein, 5 Susanna Court, Hyde Park, Boston, Mass.

Millie Breskin and Stuart Siegel as Trustees, 59 Park Road, Scarsdale, N. Y., 31 Tintern Lane, Scarsdale, N. Y.

S. M. Moisseiff, 860 Fifth Ave., New York, N. Y.

E. S. Gregg, 632 Oakland Ave., Statesville, N. C.

3. The known bondholders, mortgagees, and other security holders owning or holding one percent or more total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation acting as such trustees; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

ALAN S. COLE, Publisher

Sworn to and subscribed before me this, 25th day of August, 1959.

[SEAL] BEATRICE GROVE

Notary Public, State of New York No. 31-6689250. Qualified in New York County. Commission expires March 30, 1960.

CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Mchry and Equip for Sale

FOR SALE: Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used. Two-head Bottle Blowing Machine. Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Ill. TUxedo 9-1328.

FOR SALE: 6—New Farrell Birmingham 14" x 30" two roll Mills. Watson Stillman 240 ton, ten 24" x 50" platens. Baldwin-Southwark 200 ton semi-automatic transfer molding press. French Oil 250 ton 38" x 28". 225 ton 16" record presses. French Oil 120 ton self-contained. Hydraulic pumps and accumulators. New ¾ oz. Bench Model Injection Machines. Van Dorn 1 to 2½ ounce. Other sizes to 100 oz. Baker-Perkins and Day jacketed mixers. Plastic Grinders. Seco 6" x 12" and 8" x 16" mills and calenders. Hartig 3¼" Plastic Extruder. Single and Rotary preform presses ½" to 4". Partial listing. We Buy Your Surplus Machinery. Stein Equipment Company, 107-8th Street, Brooklyn 15, New York.

REMOVAL SALE—(MOVING TO NEWARK, N. J.) PRICES SLASHED 20 TO 50%; 1—Baker Perkins 100 gal. Sigma blade Mixer; 1—Baker Perkins size 16 TRM, 150 gal. double arm, Vacuum Mixer; 1—Rotary Cutter; 1—Kent 6" x 14" three roll mill; 6—Stokes Model DD2, DS3, and B2 Rotary Preform Presses; 4—Stokes Model "R" single punch Preform Presses. Also: Sifters, Banbury Mixers, Powder Mixes, etc., partial listing; write for details; we purchase your surplus equipment. Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

LIQUIDATION PLASTICS PROCESSING PLANT: Allsteele chunk grinder, 75 HP; Foremost granulator, 50 HP; 6000# ribbon blender; 80 HP package boiler; Entoleter impact mill; 6" x 12" lab mill; Preco 20 ton lab press; sifters, conveyors, scales, etc. Write or wire Chemical & Process Machinery Corp., 52 9th St., Brooklyn 15, N. Y., Phone Hy 9-7200.

MOST MODERN PACKAGING AND PROCESSING MACHINERY Available At Great Savings. Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Pneumatic Scale Automatic Carton Feeder, Bottom Sealer, Wax Liner, Top Sealer with interconnecting Conveyors. Pneumatic Scale Tite Wrap. Fitzpatrick Models D and D-6 Stainless Steel Comminuters. Baker Perkins and Day 50 and 100 gal. Steam Jacketed Stainless Steel and Steel Double Arm Mixers. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers, Jacketed and Unjacketed. Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Mikro Pulverizers, Models 1SH, 2TH, 3TH and 4TH. Colton 2RP, 3RP, 3B, 5½ T Tablet Machines. Stokes DD2 and Eureka Tablet Machines. Standard Knapp, A-B-C Ferguson Carton Sealers. Union Standard Equipment Company, 318 Lafayette Street, New York 12, N. Y. Phone: Canal 6-5334.

FIRST CLASS EQUIPMENT FROM YOUR FIRST SOURCE: Unused F-B. 2 Roll Plastic or Rubber Mills, 14" x 30" complete; Baker Perkins Heavy Duty Jktd Mixers up to 500 Gal.; Special 300 Gal. Stainless Vacuum Mixers, Sigma Arms; Bot. discharge; 250 Ton Self Contained Laminate Press; F.-B. 3 Roll Calender 8" x 16" compl; Preform Presses, Rubber Cutters etc. First Machinery Corp., 209 10th St., Bklyn. 15, N. Y. Phone ST-8-4672.

FOR SALE: 43—Baker-Perkins #17, 200 gal. jacketed mixers. sigma and duplex blades, many with individual 30 HP motors and drives, power-screw tilts. 2—Baker-Perkins 100 gal., sigma or dispersion blades, jacketed. 3—Baker-Perkins 50 gal., sigma blades, jacketed. 2—J. H. Day 35 gal. sigma blade. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: MOLDING MACHINES: 48 oz. Jackson & Church, Universal Hydraulic Compression and Injection Molder, 570 Ton cap. Mfg. 1951—Like New. 28 oz. Watson-Stillman, 1946. 12 oz. Watson-Stillman, 1940. 8 oz. Reed-Prentice, 10D8, 1940. Ferro Equip. Co., 5454 Bellvue, Detroit 11, Mich. WA 5-2230.

FOR SALE—2—MPM 1½" and 2½" electrically heated plastics extruders; 1—Baldwin Southwark 150 ton self-contained compression molding press; 1—Cumberland 7" stair step dicer; 4—Farrell Birmingham 14" x 30" plastics mills; 2—Ball & Jewell rotary cutters, 2, 5 HP; also preform presses, blenders, presses, etc. Chemical & Process Machinery Corp., 52 9th St., Brooklyn 15, N. Y., HY 9-7200.

FOR SALE DUE TO CLOSING of General Electrics Plastics Department—Two (2) 200-oz. Jackson-Church vertical injection molding presses. Good condition. Equipped with 6" extruders as preplasticizing units. Clamping force—1200 tons, maximum stroke 42", maximum daylight 60", clearance between stress rod 48"—L to R and F To B, maximum injection pressure 10,000 PSI platen size 77" x 77" high speed closing and opening with Vickers hydraulic units. Minimum floor space requirements. Ideally suited for large part moldings such as cabinets, furniture drawers, etc. General Electric Co., 2200 North 22nd St., Decatur, Ill.

THIS MONTH's SPECIALS: 1000 Ton Presses; Very Late Type: Baldwin-Southwark with 60" stroke; 11' daylight opening. 50" L to R x 56" F to B; Clearing with 74" stroke x 11' daylight opening, 54" L to R x 56" F to B. Hobbing Presses: 1000 Ton and 1200 Ton, both Self-Contained. Multi-Opening Presses: 1000 Ton Elmes with (11) 37" x 37" steam platens, 30" diameter ram, priced right before removal. 150 Ton Watson-Stillman with (8) 24" x 24" steel steam platens. Injection Molders: 1 oz. Van Dorn, complete; 1 oz. Vertical Laboratory type with instruments and controls. Scrap Grinders: Cumberland #1½ with 10 HP motor; Ball & Jewel #1½ with 30 HP XP motor; Ball & Jewel M-200, late type. Extruders: NRM 1½", 2½", 3½", all self contained; Royle #½ with 1⅛" diameter screw, an excellent lab piece. We Will Finance. Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 2, N. J. Bigelow 8-2500.

FOR SALE: (23) Potting Presses, 100 Units per hr. Cap., Bed 24" x 24". Vertical Injection Press, (with modifications, can be used as ¾ oz. injection molders) manually controlled with micro switch which sets into operation cycles for performance of potting operation. Motor drive activates agitator for flow of material (plastic from a hopper into a heating cylinder). Mfg. 1951—Like New. Ferro Equipment Company, 5454 Bellevue, Detroit 11, Mich. WA 5-2230.

EXTRUDER 2½ NRM MODEL 50, serial 5896, Year 1953, Electric Heat, Four screws, 10 HP U.S. Vari Drive. Western Textile Products Co., 2131 Hickory St., St. Louis 4, Mo.

Machinery wanted

WANTED—3¼" or 3½" Extruder, barrel ration at least 20/1, Hartig preferred, also Pelletizer. Advise full details. Erie Plastics Co., 1221 Walnut St., Erie, Pa.

MACHINERY WANTED: Extrusion die for vinyl sheeting 15" opening. Reply Box 6000, Modern Plastics.

WANTED TO BUY: One 1A and 3A Banbury Mixer for plastics. One Vacuum Forming machine for skin-packing—30" x 30" or larger. Reply Box 6001, Modern Plastics.

WANTED HPM 80/100 OZ. 1955/56/57—1000/1200 Tons clearance between tie rods 40" x 48". Write: GPI 30 rue Massenet Coeuilly-Champigny, France.

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass., PLeasant 7-7747, 5222 West North St., Chicago, Illinois, TUxedo 9-1328.

Materials for sale

GENERAL PURPOSE, MEDIUM AND HI-IMPACT POLYSTYRENE AND POLYETHYLENE molding materials for sale in any color or quantity. Packed in 50 lb. bags. Now at our lowest prices in years. For top quality materials, at big savings, write: Gering Plastics division of Studebaker-Packard Corp., Kenilworth, N. J., Dept. M. Or call: (N.J.) BRidge 6-2900.

Materials wanted

WANTED: Butyrate, Kralastic, Cycolac. Also Styrene, Acetate And Other Plastic Scrap. Claude P. Bamberger, Inc., Ridgefield Park, N. J. HUbbard 9-5330.

URGENTLY NEEDED: Nylon, Cycolac, Kralastic, Tyril, C 11 and most other thermoplastics in all forms. Highest prices for immediate delivery. Send samples to Gem City Trading Corp., P.O. Box 941, Dayton 1, Ohio.

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates; acetates, acrylics, and polyethylenes in any form. Write, Wire or Phone Collect. HUmboldt 1811. Philip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York.

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

GET THE TOP MONEY FOR PLASTIC SCRAP: Now paying top prices for all thermoplastic scrap. Wanted: polystyrene, cellulose acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE TODAY! Reply Box 6030, Modern Plastics.

WANTED: Plastic scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 514 West 24th Street, New York 11, N. Y.

Molds wanted

WANTED: Injection molds new or used for a 3 oz. Eckert & Ziegler EH 160 injection molding machine to be used with scrap from Plastisol Doll Factory. Only submit offers of molds yielding a high sales volume. Reply Airmail "Pieldurazno" Calle 29 #46-50 Medellin Colombia S. A.

Help wanted

MARKET DEVELOPMENT SPECIALIST—To assume responsibility for determining product and application needs, recommending and directing progress on new development projects, and technical selling on a professional plane to all customer levels of the electrical insulation industry. We are manufacturers of reinforced plastics electrical insulation. Send resume to: Fiber Glass Industries, Inc., Homestead Place, Amsterdam, N. Y.

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 29 E. Madison St., Chicago, Ill.—Wabash 2-4800. Call, write or wire—in confidence.

REPRESENTATIVES WANTED: for the foremost manufacturer of die cutting equipment which trims a practically unlimited amount of rule of plastic or plastic-like materials. Additional products include: packaging machinery now making the most successful blister packages. Our machines can meet the requirements of small or large production. Various territories open throughout the United States. Send us a complete resume outlining experience, other lines, & following. Reply Box 6031, Modern Plastics.

WANTED—Salesmen for plastic products. Corporation operating nation-wide. Requires man in Chicago area, and one in New York area. Although not necessary, men with some experience preferred." Reply Box 6002, Modern Plastics.

SALESMAN: Experienced in sale of thermoplastic molding powder, preferably in excess and off-grades. Must be well regarded in trade. Attractive proposition. Reply Box 6003, Modern Plastics.

(Continued on page 272)

(Continued from page 270)

NEW PRODUCTS! The Mead Corporation Laboratories have staff positions open for technically trained men who are interested in New Products Research and Development for the paper industry. If you are product-minded, creative, with interests or experience in plastics, resins, and new types of paper and board, you should consider this advertisement seriously. We offer opportunity for recognition and growth with friendly working and living conditions. Location, Chillicothe, a pleasant town of 28,000 in southern Ohio. Your inquiry with full resume will receive immediate confidential attention. Write to: Hugh E. Mellinger, Technical Employment Supervisor, The Mead Corp., Chillicothe, Ohio.

BLOW MOLDING SUPERINTENDENT. California multi-line plastics corporation is looking for a man with experience in blow molding who can take responsibility for the department including tool and product design. Reply Box 6005, Modern Plastics.

WELL-KNOWN and old established Rocky Mountain manufacturer seeks manufacturers representatives to make sales calls for industrial plastic work. New plant equipped to produce high-quality injection-molded plastic parts and able to provide tooling, stamping, roller painting, silk screening, etc. Send inquiries to Box 6006, Modern Plastics.

PLASTIC MOLD DESIGNER: Minimum two years experience. Pipe fitting design preferred. Injection and Compression Molding plant located in Cleveland area. Reply Box 6009, Modern Plastics.

EXCELLENT OPPORTUNITY for experienced sales representatives to handle complete line of blow molding machinery —extruders—wire coating and film blowing equipment. Many territories open in the U.S. and Canada. Submit details of territory covered, present representation and experience. Reply Box 6010, Modern Plastics.

UREA AND MELAMINE MOLDING POWDER EXPERT: Expanding Chemical Company requires a Chemist or Production Man completely familiar with every stage of Urea and Melamine Molding Powders production from the basic resin through to the finished powder. Location: Metropolitan New York Area. Excellent opportunity for top man to participate on a profit-sharing basis with new producer of molding powders. Please give complete details of experience in first letter. Reply Box 6004, Modern Plastics.

TOOL ENGINEER—INJECTION MOLDING: Experienced tool designer for established company with proprietary line of plastic products, sold in volume. Must be aggressive, imaginative and willing to assume responsibility of full tooling program. Responsible position with strong future and all benefits. Upstate New York. Salary open. Send resume and full details. Reply Box 6007, Modern Plastics.

EXTRUSION SPECIALIST: With thorough knowledge and experience in set-up of extruded precision shapes, close tolerance tubing, for permanent position in New York with old, established custom extrusion company. We are looking for man with actual working knowledge, not administrator. Assistance will be given in relocation. Position offers chance for advancement. Reply Box 6008, Modern Plastics.

PLASTIC SALES: For men capable in selling plastic materials. This is a major opportunity. Because of the dynamic growth of our plastics market we need additional sales representatives to cover Midwest territories, calling on molders, extruders, calenderers, and "end users." Applicants should have 2 to 7 years experience in field sales or sales technical service in plastics, rubber, or allied fields. Moving expenses paid; car furnished; incentive with salary. E. M. Mills, Personnel Director, Marbon Chemical, Div. of Borg-Warner, Box 68, Washington, W. Va.

PLANT MANAGER: Small California plant desires man with laminating and tooling experience. Wonderful spot for top-notch operator. Reply Box 6011, Modern Plastics.

MANUFACTURERS' REPRESENTATIVES to sell recognized quality pearl essence. All territories open. Must be well known to the compounders, extruders, molders, casters, and coaters. Argenta Products Co., 74 Forrest St., Jersey City, N.J.

CHIEF ENGINEER: Well established plastics company in Central New England has an opening for a person who has had at least 2 years experience as a Chief Engineer and a minimum of 10 years experience in Mold Design, preferably in the toy and novelty line. Extrusion experience helpful. Five figure salary to commensurate with experience and background. All replies kept confidential. Please send resume and references. Reply Box 6012, Modern Plastics.

MECHANICAL OR INDUSTRIAL ENGINEER with injection molding experience. Diversified midwestern manufacturer recently entered molding field—requires Engineer with plastics experience to work in general office. Reply Box 6013, Modern Plastics.

MOLDMAKER: First Class man. Experience construction and repair of compression molds. Large Metropolitan New York manufacturer. Permanent; benefits. Write salary. Reply Box 6014, Modern Plastics.

SALES REPRESENTATIVES WANTED: by machine company manufacturing article used in plastic and textile industry. Territories open. Will assist in leads and advertising campaign. On commission basis. Reply Box 6016, Modern Plastics.

REPRESENTATIVES WANTED: Men calling on injection molders, extruders, vacuum formers in Detroit, Cleveland, Chicago and St. Louis to add additional line. Write advising lines presently representing. Reply Box 6017, Modern Plastics.

WANTED: Manufacturer's Representative with product ideas adaptable to injection molding by midwestern injection molder desirous of establishing proprietary items. Reply Box 6028, Modern Plastics.

R & D ENGINEERS: Good opportunity for plastics engineer with approximately 5 to 10 years experience in molding and process work and with good general knowledge of plastics field. Work is on all phases of product and process work with leading New England plastics research and development laboratory. Send resume to Mr. M. Mead. DeBell & Richardson, Inc., Hazardville, Connecticut.

MANUFACTURERS REPRESENTATIVE to sell in Chicago area for custom injection molder located in Chicago. We have decorative department and have done work in automotive, appliance, household and practically all other fields. Reply Box 6022, Modern Plastics.

PLASTICS LABORATORY ASSISTANT: Prefer man minimum H. S. with some experience in thermo plastics. Work entails quality control, blends of plastics, color matching and some development work. Permanent, challenging position. State experience and salary desired. Mail Resume or apply in person. Alpha Chemical & Plastics Corp., 1 Jabez St., Newark, N. J. Tel: MArket 4-4444.

CHIEF CHEMIST: One of the nation's foremost manufacturers of polyvinyl film has an opening for a man experienced in formulating for Calender production, to take full charge of it's laboratory. A terrific opportunity for the right man. Please reply in confidence. Reply Box 6032, Modern Plastics.

Situations wanted

PLASTICS EXTRUSION ENGINEER, M.S. degree. 9 years experience first-hand development and production of polyethylene film and large variety of extrusions in all plastics. Full experience in die and machine design, set-up, and continuous production. Added know-how in packaging, sales, and plastics compounding. Prefer N.Y.-N.J. metropolitan area but will relocate. State salary offered. Reply Box 6019, Modern Plastics.

CONSULTING CHEMIST: with thirty years experience in the development, manufacturer, and application of phenolic and urea resins, adhesives, and molding compounds available for consulting and product development work. Reply Box 6018, Modern Plastics.

TWO PLASTIC and fountain pen experts, one a U.S. and the other British citizens, desire change in position in high executive capacity with progressive company. Write in first instance to, Mr. Gordon Casilla de Correo, 79 Sucursal 16, Buenos Aires, Argentina.

PLASTICS ENGINEER with five years experience in development, production, testing and sales service of thermoplastics compounds desires to utilize talents with progressive organization. Emphasis has been on gum plastic compound development for extrusion and injection molding. Alert, agressive, willing to relocate. Reply Box 6020, Modern Plastics.

PLANT MANAGER: Plastics Engineer, B. S. in M. E. Desires position with progressive organization. Experienced in plant operation, layout; selecting, training personnel; budgeting, planning operations; have set up successful plant operation. Background molding thermoplastics, design operation of molds, machines and assembly equipment. Detailed resume on request. Reply Box 6021, Modern Plastics.

Miscellaneous

LOOKING FOR A SMALL, growing plastic manufacturing company as an investment and active participation. Give reasonable information. All replies will be kept strictly confidential. Reply Box 6023, Modern Plastics.

WANT TO PURCHASE full or majority interest in compression, transfer molding in N.Y. Metropolitan area. Also will purchase compression and transfer molding presses 75-100 ton self contained. Reply Box 6024, Modern Plastics.

A BRITISH CHEMICAL engineering and contracting company is now free to consider the further application of U.S. processes and specialist equipment in the chemical industry. Old established, highest reputation, ample financial resources. Design, research, technical service and sales facilities are available. Also space for pilot plant work. Manufacture can be arranged in Britain and, if necessary, in continental Europe for the Euromarket. Please write in first instance, giving brief details. Reply Box 6025, Modern Plastics.

SELFADHESIVE TAPES — colored and clear — of cellulose and vinyl, also masking from nondomestic factory. Contacts wanted to companies interested in selling this line. In some countries manufacturing licenses are available. Reply Box 6026, Modern Plastics.

INTERESTED IN PURCHASING continued supply of both a soft and a rigid PVC scrap, Extrusion Co., Reply Box 6027, Modern Plastics.

MANUFACTURERS REPRESENTATIVE: 20 years experience in plastic sales, extrusion, compression and injection molding, industrial engineer, extensive contacts, sales office. Interested in AAA manufactures with larger volume sales potential in the Chicago midwest area. Commercial and banking references available. Reply Box 6015, Modern Plastics.

DUTCH PLASTIC ENGINEER, 39, office located in Holland, broad experience, business mgt., molding equipment, tech. service, exc. organizer, travelled, thorough knowledge of European market, acquainted with US-tech. requirements, speaks French, German, English; desires to extend his activities for US-firms as liaison engr., purchase repr., confidential commissioner. Reply Box 6029, Modern Plastics.

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These photographs show curved roof canopies, curved rear windows and internally illuminated name plate and weatherguards made from 'Perspex' in a coach built by Duple Motor Bodies Ltd. The hinged roof ventilators are made from 'Perspex' by Weathershields Limited.

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Canadian Industries Ltd., Plastics Division, Box 10, Montreal, P.Q.

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EDITORIAL

Private consultants—their place in plastics

As the range of plastics materials broadens, as applications for plastics increase, and as engineering design becomes more sophisticated, the consulting engineers and the creative service and testing laboratories become more important, particularly to industrial end users.

Questions to which these organizations can find answers are many. They range through selection of material, design for strain-free parts, weathering properties under various climatic conditions, machine design or adaptation for specific purposes, shelf-life of containers, etc. In some cases they involve production of prototype parts on short-run molds to secure a balance of strains fairly close to those which might be expected in the final product. In some cases they involve the fabrication of prototypes for testing.

Naturally, to the medium-sized company with one-shot problems, the specific talents of the independent consulting companies are most useful because they may obviate capital investment in special testing equipment, provide technical manpower otherwise completely unavailable to the company concerned, and produce results more quickly than would be otherwise possible.

But to the huge companies well staffed and well equipped in laboratories, these people can also provide economies. There are many case histories of single projects where it has been more economical for a big company to farm out the work to independent consultants than to tie up men, machines, and real estate on a temporary basis. This can eliminate added insurance, fringe benefits, clerical work, and overhead. It is a matter of "costing out" the project as handled by staff against the same work as it could be handled independently, and frequently the costs are in favor of the outside consultant.

Finally, the growing trend toward consulting between independent consultants can provide an assembly of special talents that is pretty hard for many companies to match from staff.

Of course, the selection of a consultant or a special service laboratory is never a simple matter. There are scores of independent consultants on plastics. Selecting the best company for any given project is a matter of relating the men, equipment, and record of accomplishment to the requirements of that project, whether it be a matter of evaluation or of creation.

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